VOLUME 30 JULY 1937 NUMBER 7

Southern Medical Journal

Journal of the Southern Medical Association

Copyright, Southern Medical Association, 1937. Published monthly by the Southern Medical Association, Empire Building, Birmingham, Alabama. Annual subscription, $4.00. Entered as Second-Class Matter at the Post Office at Birmingham, Alabama, under Act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized December 20, 1921.

Southern Medical Association, New Orleans, Louisiana, November 30 - December 1-2-3, 1937

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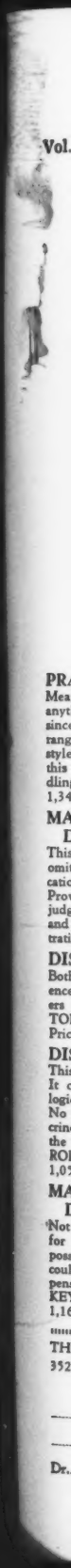

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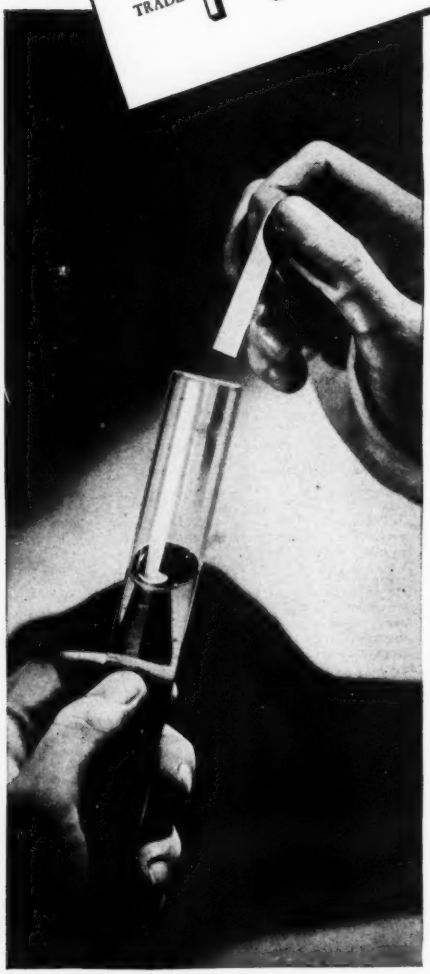

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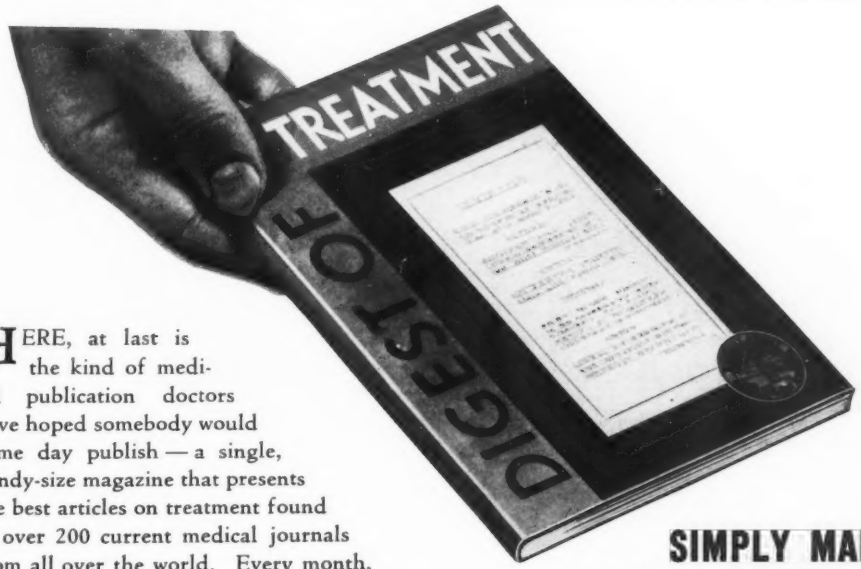

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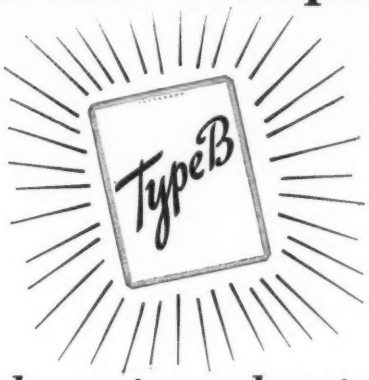

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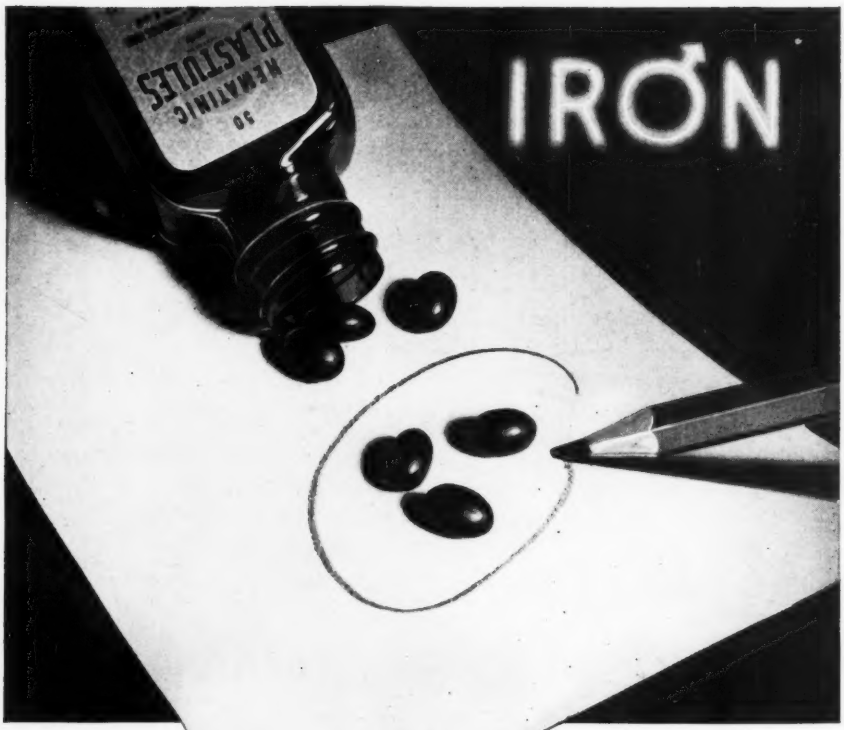

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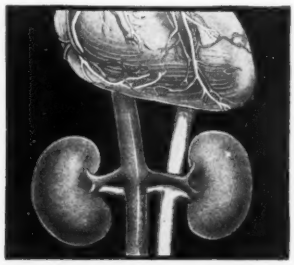

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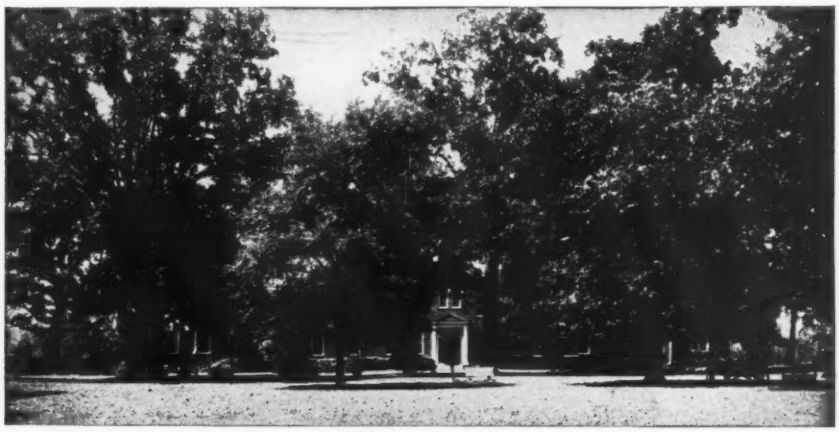

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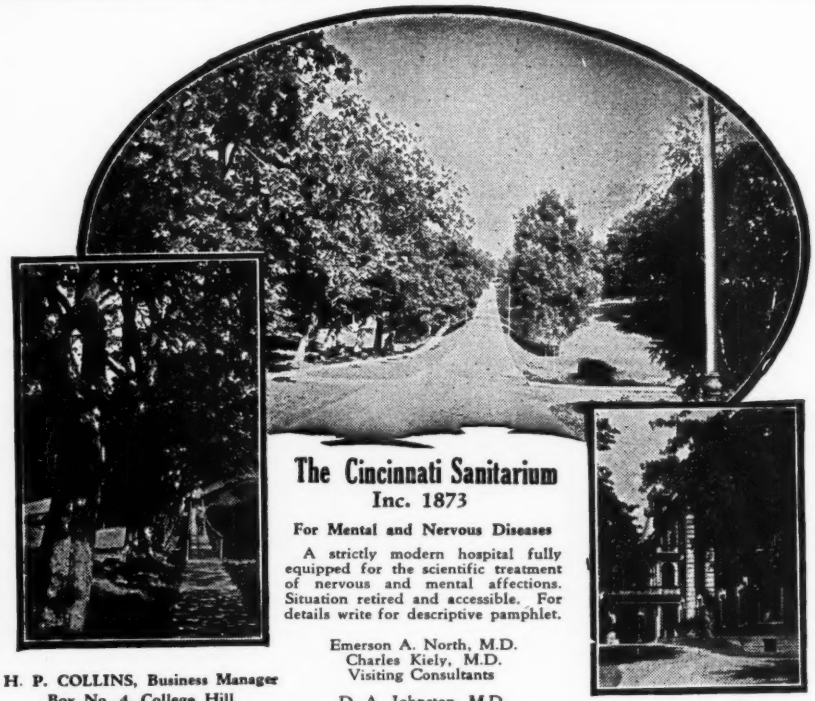

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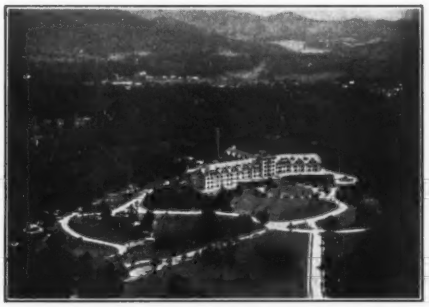

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Volume 30 JULY 1937 Number 7

SUBTENTORIAL TUMORS*

By W. T. COUGHLIN, M.D.
St. Louis, Missouri

The first man who operated deliberately and successfully for the removal of a brain tumor was Rickman J. (later Sir Rickman) Godlee, of London, in 1884. The diagnosis and localization were made by H. Bennett. The tumor was found as localized, and entirely removed. The patient did well for four weeks, but developed a hernia cerebri, which was the focus of meningitis, with exitus. After this case was published, MacEwan, of Scotland, claimed that he had several times successfully operated for brain tumor, although he had not published his results. Under the leadership of Horsley in England and Krause in Germany for the next twenty years brain surgery was being developed. Krause was the first to be successful in the surgery of tumors below the tentorium.

To work and study with these pioneer leaders in the early years of this century went Harvey Cushing forth from the wards of Johns Hopkins; and, thanks to his patient and painstaking effort, his brilliant mind, his breadth of vision, his wealth of genius, his unsurpassed skill and his ability to charge the minds and hearts of his disciples with the fire that fills his own, brain surgery in the United States today enjoys an envied reputation in the clinics of the world.

Any tissue below the tentorium may be the source from which a tumor springs, and though the rate of growth may be fast or slow, though they may bear the benign character of a wart or the malignancy of a small round celled sarcoma, and even though metastasis in the common sense of the word has never been heard of, yet unless removed by surgical means they always kill the patient. One hundred per cent mortality if untreated!

*Received for publication December 1, 1936. Read in General Clinical Session, Southern Medical Association, Twenty-Ninth Annual Meeting, St. Louis, Missouri, November 19-22, 1935.

It is this last thought that steels the heart of the neurosurgeon against discouragement at what to the ordinary surgeon looks like a prohibitive operative and postoperative mortality rate. Truly, they work with a courage and ardor worthy of a still greater success.

Tumors may arise from the bones, ordinary osteomata; from the meninges, meningiomata (formerly called dural endotheliomata); from the cerebellum, pons or medulla or from choroid plexus or from the blood vessels or nerves found anywhere within the cranium.

Cysts of various kinds are sometimes found here and are usually serous in character. A midline epithelial cyst due to error of development in the closure of the medullary groove is sometimes encountered; in fact, a solid tumor may come from such a source. Benign serous cysts have been recorded, but now-a-days when we uncover a serous cyst within the brain we open it and make diligent search within for its cause, which is usually found to be a glioma situated in its bottom or wall. This must be totally removed or destroyed or the cyst will recur.

The cerebellum is a special nesting place for the gliomata in children and very many of these develop cysts, apparently more so than those elsewhere. These gliomata are usually tumors of an infiltrating type and when so their total removal cannot be accomplished after they have attained large size. There is one variety at least that is fairly amenable to radiation, the medulloblastoma (*Figs. 9* and *10*), which, according to Cushing, is the common cerebellar glioma of childhood.

Tumors grow inside the fourth ventricle. Angiomata for a very special developmental reason grow here and are found frequently in those bearing port - wine stains somewhere on the surface of the head, neck or trunk. The choroid plexus is the point of origin of a papillary tumor (*Figs. 5* and *6*), solid or cystic, which has been known to undergo mucoid, fibrous and even bony degeneration. Here, too, tumors spring from the subependymal layer within the ventri-

cle, papillary or solid, and are often widely disseminated over the surface of brain and cord, being spread about by the movement of the cerebrospinal fluid.

Of the nerves serving as origin for subtentorial tumors, the eighth or acoustic is the most prolific and the type is the fibroblastoma springing from the sheath of the nerve (*Figs. 12* and *13*).

Without a knowledge of the gross anatomy and physiology of the brain it will always be impossible for anyone to arrive at a correct diagnosis and localization of tumors of the brain. To aid us in our efforts to locate the subtentorial tumor we must remember the functions of the cerebellum. It is the equilibrator of our bodies and the fixator of our joints. Without it we cannot recognize and maintain our proper relations in space nor properly coordinate our muscular movements. It also has something to do with the maintenance of normal muscle tonus and regulates our strength. Unlike the cerebrum, it exerts its influence on the homalateral half of the body.

Let us remember the situation of the fourth ventricle and the position of the centers of the nuclei of the cranial nerves from fifth to twelfth inclusive on either side of the midline just under its floor, and in the lower half the position, I may say, of the centers of life itself, the vasomotor and respiratory. And now this fourth ventricle, like any other ventricle, contains a choroid plexus which with all the other choroid plexuses pours forth its secretion, the cerebrospinal fluid. A gland-like apparatus, this choroid plexus, but differing from any other gland anywhere else, its secreting epithelium is on its outside surface. This fourth ventricle has opening into it above the aqueduct of Sylvius, the road from the third to the fourth ventricle, and a constant stream of cerebrospinal fluid is pouring from it into the fourth ventricle. This fluid must have an exit from the fourth ventricle, and there are three foramina for this purpose: an opening in the midline in the lower half of the roof, the foramen of Magendie, an opening on each side in what is called the lateral recess, the foramina of Luschka (*Fig. 1*). Through or along each of these last two there extends toward the antero-lateral surface of the medulla

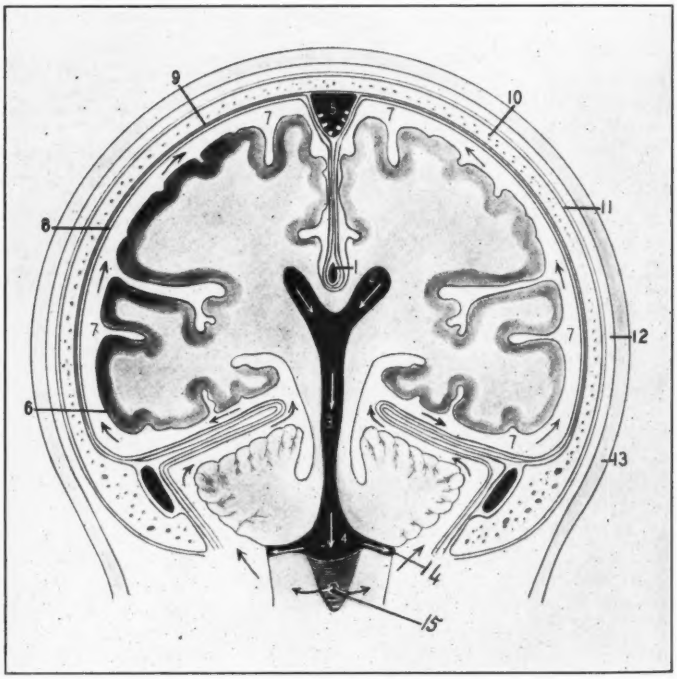

Fig. 1

1. Inferior longitudinal sinus in concave edge of falx cerebri.
2. Opening from lateral to third ventricle (foramen of Monroe).
3. Third ventricle and iter. (Artist has failed to show where one begins and the other ends.)
4. Fourth ventricle.
5. Superior longitudinal sinus.
6. Pia.
7. Subarachnoid space.
8. Arachnoid.
9. Dura (in two layers).
10. The diploe.
11. Outer table and pericranium.
12. Subaponeurotic space.
13. Scalp.
14. Foramen of Luschka.
15. Foramen of Magendie.

a bit of the choroid plexus which thus projects out into the subarachnoid space. Passing through these foramina the fluid finds itself between the brain and the arachnoid membrane. Over all of the surfaces, down over the cord and upward over cerebellum, midbrain and cerebrum it spreads, filling cisterns and sulci and being at last resorbed or excreted into the venous sinuses and veins (*Fig. 1*).

You, following the path of the cerebrospinal fluid (*Fig. 1*), can easily see that a slight displacement of the midbrain, pressing it against the edge of the tentorial opening, may block the iter or aqueduct of Sylvius. A growth in the aqueduct itself or in the fourth ventricle will do the same and a superior hydrocephalus will result, while a growth anywhere outside the ventricle may cause the cerebellar hemispheres to project upward and prevent the fluid from getting above the tentorium along its subarachnoid channel and so prevent its absorption and lead to a dilatation of all of the ventricles and a compression of the cerebellum.

And while speaking of the pushing upward of the cerebellar hemispheres as a consequence of increased subtentorial pressure, let me call attention to the fact that any increase of intracranial pressure will cause more or less pushing downward of the inferior portions of each hemisphere (the tonsils) sometimes even so as to wedge them tightly into the foramen magnum alongside of, or dorsal to the medulla, and let me bring once more to our minds, as was first done by Fürbringer in 1896 and again by Gumprecht in 1907, the terrible danger of doing a lumbar puncture in such a case. Removal of fluid by lumbar puncture in the presence of increased intracranial pressure may quickly cause the death of the patient.

The diagnosis is the most important consideration in brain tumor cases. The early recognition of the condition will lead to its early treatment. If any brain tumor is received by any surgeon only long after the intracranial tension has reached a very high level, when, for example, the patient must be carried into the hospital, the probability is very strong that he will have to be carried out after operation. The earlier the operation the better the prognosis.

There are four cardinal signs of increased intracranial pressure, namely: headache, vertigo, vomiting and failing vision, and if a patient comes to the physician with all of these or with only the first three or only the last one, it is the duty of the doctor to prove as soon as possible that the patient has or has not a brain tumor.

Headache is not always present; especially is it often absent in children because of the yielding of the sutures, and the head enlarges as the tension increases. Such a case may be diagnosed hydrocephalus (*Fig. 7*). The patient with the subtentorial tumor more often than the others, it seems to me, indicates the tumor site as the site of greatest pain. Pain in the neck muscles, shoulders and arms, or a sense of constriction around shoulders and upper chest is very common, but generalized headache often accompanies these. The muscles may be stiff and the head held to one side or forward or back. Beware not to return it forcibly to normal. Sudden death or convulsion may occur.

Vertigo, dizziness, is common and there is a tendency to fall. Usually the patient falls toward the side on which the tumor is or forward or backward when it is in the midline. He early learns his weakness in this respect and tries to overcome it by walking or standing with his feet spread apart. He reels from side to side as he walks, and whether in darkness or by good daylight, he staggers along like a drunken man.

The vomiting will almost surely ensue, although it may be delayed. Sometimes it is an early symptom. So often have we heard of it as projectile in type that some have come to believe that it must always be so. In my experience it is not so often of the projectile as of the ordinary type. It frequently first appears in the morning, and while it often is a surprise event to the patient or others, it is also often preceded by nausea.

Failing vision may be the first and for a long time the only symptom. In two of these cases the diagnosis was first made by the oculist, but strange though it seem, a subtentorial tumor may become almost as large as a hen's egg and yet the discs may remain normal (*Fig. 12*). The choked disc, however, is usually an accompaniment of increased intracranial pressure and it must be borne in mind that if choked disc continues for very long, vision will probably be permanently impaired or lost altogether.

Nystagmus, usually lateral, is to be expected if the tumor is large and lateral, but sometimes it is not present.

Tumor of the acoustic nerve, the tumor of the cerebellopontile angle, grows from the sheath of the nerve and usually begins inside the bony canal (*Figs. 12* and *13*). It early gives notice of its presence. There is a roaring or a noise as of escaping steam or a shrill whistle in that ear, and the hearing therein soon becomes defective. Presently hearing in that ear is lost alto-

gether. These tumors grow slowly as a rule and it may be years before the seventh nerve is pressed upon enough to paralyze it. Give it time, however, and this will happen, as will also pressure on the fifth, which may beget parasthesiae, numbness of face or loss of conjunctival (corneal) reflex. When large enough, cerebellar function will be impaired, "The hand loses its cunning," headaches appear and presently pressure on pons and medulla produces paralysis of swallowing muscles or of limbs or of the vital centers themselves.

Patients with loss of cerebellar function cannot make properly coordinated movements. The patient cannot lightly touch finger tip to finger tip, or finger tip to tip of nose. He does not do it the same with both hands. If he lies down on his back, he cannot lightly touch heel to knee; he fumbles, as it were, and more so on the side on which the tumor is.

The reflexes are variable in their response to subtentorial tumor, but it is very usual for deep reflexes to be obtunded or to disappear entirely, and usually first on the affected side. A general body weakness or rapid loss in weight is sometimes seen (*Case 1*). This has been attributed to the vomiting, but it is not always so.

Paralyses of various of the cranial nerves occur commonly perhaps of the eighth, seventh, fifth and sixth. Usually if those below the ninth are early paralyzed the tumor is invasive in type and involves pons and medulla. Total paralysis of a limb is not often seen, but paresis of a hand or foot is common. A teacher with a right-sided tumor first noticed that her hand tired as she wrote on the blackboard and she could not keep the line level. Another lady found she could not deal the cards and had to learn to do so with the other hand. *Case 3* complained of numbness of the left leg.

Paresthesiae or anesthesia may occur, depending on pressure perhaps. *Case 1* had right-handed astereognosis and the tumor had flattened the right inferior peduncle of the cerebellum.

Convulsions are not so common as with supratentorial growths, but they do occur. They are usually accompanied by loss of consciousness. *Case 2* had attacks of twitching in face and shoulders, but no loss of consciousness. Dyspnea and cyanosis, followed by loss of consciousness and cessation of respiration, have been often seen with tumor in the fourth ventricle.

Changes in mentality and personality are not frequent. They do, however, occur. *Case 1* showed facetiousness ("Witzelsucht") and *Case 3* irritability. It is probable that long-continued intracranial pressure, no matter how produced, could bring about such changes or even more serious ones.

Finally, if a diagnosis cannot be made or a tumor localized in any other way, we have (thanks to Dandy, of Johns Hopkins) an unfailing means at our disposal, ventriculography. The method is, of course, not free from danger, but the question of the tumor's location must be decided. *Case 1* was suspected of having a tumor in his left cerebral hemisphere. He had right astereognosis, undue facetiousness and a right facial weakness, but he had nystagmus and lowered tendon reflexes. The ventriculogram showed dilatation of the upper ventricles, and air injected into the spinal canal rose only as high as the arch of the atlas (*Fig. 2*), thus giving the correct location of the tumor.

Whether it is on one side or the other is not important. The great question is, is it subtentorial, for if it is, no matter which side it is thought to be on, the surgeon, knowing human fallibility, usually opens both sides by the method of Krause or that of Cushing.

The results, while not so favorable as to excite in the heart of every surgeon the desire to confine his attention to this particular field, are not entirely discouraging. So far there have been eleven out of twenty who have lived more than one year; nine have died in the hospital. Three of ours have been tumors of the fourth ventricle, now living seven, six and two years, respectively.

CASE REPORTS

Case 1.—Mr. A. S. (anesthetic, first local, second local, St. John's Hospital, September, 1929), an architect, 29 years old, married recently, had always been quite healthy. Since 1926 he had occasional attacks of double vision, worked until two months before, was bed-ridden at the time of examination and much emaciated. A year previously he began to have severe occipital headaches and dizziness, some tinnitus of both ears, and a sense of tightness or constriction across the upper chest and back. He had been losing weight for two months and had vomited almost every morning for a month, sometimes without, sometimes with nausea. He staggered when walking, tending to fall to one side or to the other, or forward or backward. For failing vision he consulted an oculist, who discovered a severe choking of both discs. His neurological examination showed a slight nystagmus, lateral, on looking to the left. The left conjunctival reflex was dull. The right sixth nerve was weak. The right side of the face was a little weaker than the left, not much. The hearing was normal, the tongue protruded in the midline. He could not distinguish common objects by their feel when they were placed in his right hand. He was peculiarly facetious, and made very light of his illness. The left abdominal reflex was diminished, also the cremasteric. The knee jerks were both sluggish. There was no ankle clonus;

the right plantar reflex was abnormal, but not the classical Babinski.

The headache, dizziness, vomiting and choked disc indicated an intracranial lesion. The obtunded reflexes, the staggering gait, the tendency to fall, pointed to a lesion below the tentorium, but the right face weakness, the right plantar reflex and the right astereognosis seemed to indicate a lesion in the left frontal lobe; added to this the patient's facetiousness and silly answers seemed to confirm this. However, it was decided to make the ventriculogram, and this disclosed that the patient had a tremendous hydrocephalus, limited to the third and lateral ventricles. A spinal puncture was then done and the fluid replaced by air. The air rose in the spinal canal only as far as the cervical vertebrae (*Fig. 2*). A cerebellar decompression was done, but because of the condition of the patient the operation was discontinued without opening the dura. He improved very much and two weeks later the dura was opened and a tumor found in the space between the tonsils of the cerebellum and the vermis, pushing downward into the foramen magnum behind the cord (*Figs. 3* and *4*). Because of the peculiar mother-of-pearl colored covering, not only on its exposed surface, but also on the exposed surface of the adjacent parts of the brain, it was first thought to be a pearl tumor or cholesteatoma. The microscopic diagnosis, however, was carcinoma of the choroid plexus (*Figs. 5* and *6*). The recovery was uneventful.

The following winter this patient had an attack of flu, and again he presented almost the same picture which he had presented before the operation. He refused to return to the hospital. He recovered and has been well now almost seven years.

Here is a case in which undoubtedly the operation would have been performed at the wrong spot had it not been for Dandy's wonderful discovery, ventriculography. The astereognosis was explained at the operation when we saw that the tumor had flattened the posterior peduncles of the cerebellum, particularly that portion of it made

Fig. 2, Case 1
Operated 1929. Patient still alive and well June, 1937. Ventriculogram fails to fill fourth ventricle. Air injected by lumbar puncture immediately afterward rises as high as the arch of the atlas only.

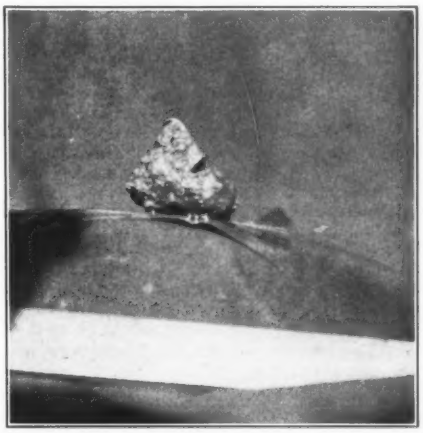

Fig. 3, Case 1
The tumor removed. Note bosselated surface. A bit has been excised for examination. The photograph is poorly made. The twelve-inch rule below gives an idea of the size.

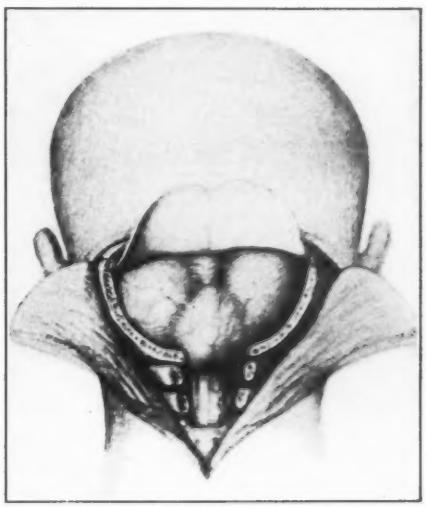

Fig. 4. Case 1
Artist's drawing to illustrate position and appearance.

up of the dorsal columns, and more so on the right side. Another peculiar phenomenon that has been noticed also by others who have removed tumors from the fourth ventricle was that the patient complained very much of pains in his stomach while we were enucleating the tumor.

While the microscopic diagnosis of papillary carcinoma of the choroid was made, it is now seven years since the operation, and the patient is still perfectly well. I must say that he has had x-ray treatment. My own opinion is that this is a simple papilloma of the choroid plexus (*Figs. 5* and *6*).

Case 2.—J. K. (anesthetic, avertin and ether, St. Mary's Hospital, May, 1930), a boy, 5 years of age, complained for a year of frontal and occipital headaches, worse in the morning and lasting all day. Attacks of vomiting every two or three weeks lasted from six to twelve hours. Six months previously he had an attack of influenza, followed by twitching of the face and shoulders, diagnosed chorea. He recovered from this, but continued to have attacks of headache and vomiting. Later he began to have difficulty in walking, staggered, kept the feet wide apart. The twitching of the face, shoulders and arms recurred and became worse. For two months he had been unable to walk at all, and for a month had been unable to sit up in bed.

When first seen he was apathetic, very slow in answering, the head looked large (*Fig. 7, right*). If brought to a sitting position and left unsupported he fell forcibly backward and sometimes to either side. The neck was stiff. There was a positive Kernig sign on the left. A spinal puncture had already been done. The tension was high, the cell count normal. Wassermann and Kahn were negative. He had double choked

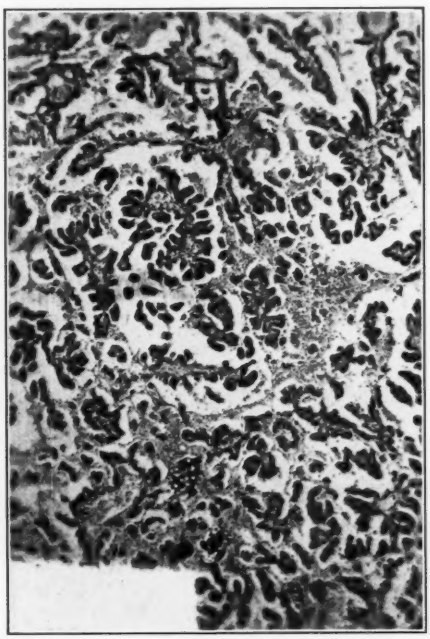

Fig. 5, Case 1
Papilloma of the choroid plexus, low power.

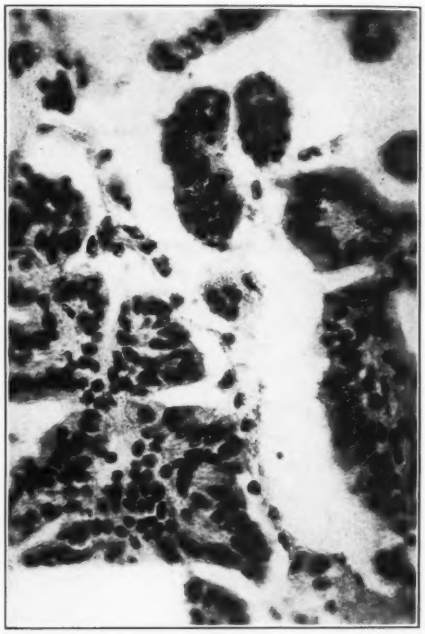

Fig. 6, Case 1
Papilloma of the choroid plexus, high power.

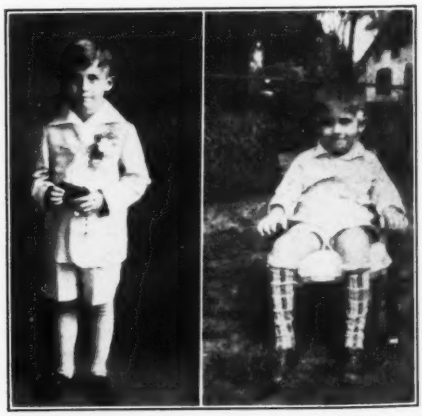

Fig. 7, Case 2
Operated 1930. Patient still alive and well October, 1936. At right, child shortly after operation. Head shows some hydrocephalic tendency. At left, same child one year later.

discs and adiadochokinesis in the right hand. Knee jerks were absent, abdominal reflexes weak, cremaster normal, no cranial nerve palsy, and the x ray was negative. The diagnosis was hydrocephalus, probably due to a tumor below the tentorium. The shape of the head,

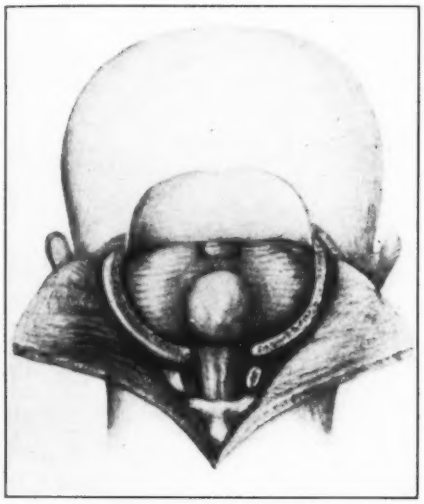

Fig. 8, Case 2
The artist's attempt to illustrate from description. The tumor is cystic. The growth arose from the right restiform body, mostly on the medial side.

the slow progress, the signs of high intracranial tension supported the former belief. The walking with wide base, the staggering gait, the lowered reflexes, the adiadochokinesis, pointed toward cerebellar dysfunction. A ventricular puncture with air injection was done, which showed great hydrocephalus, but no air below the tentorium.

A cerebellar decompression was done, which immediately relieved his headache and vomiting, but for a few days thereafter there was very much extensor and pronator spasm. Attacks of such fits were sometimes three or four to the hour. They later subsided and within two weeks the second stage of the operation was performed and a spherical cyst was found in the midline between the tonsils of the cerebellum and the lower end of the vermis. Here and there its surface was brain colored. It was about 2 cm. in diameter and it contained a clear fluid (*Fig. 8*). It was easily separable from the parts of the cerebellum with which it was in contact, but was firmly attached to the medulla between the inferior cerebellar peduncles. A nodule was found here within the cyst and a portion of it was removed. This was diagnosed medulloblastoma (*Figs. 9* and *10*). He was given x-ray therapy at intervals for two years.

He has now been quite well for six years, is smart, intelligent, gets about in a perfectly normal manner and does well at school.

Case 3.—Mrs. C. (anesthetic, first local, second local, Firmin Deslodge Hospital, July, 1933), a woman, 48 years of age, had been married at 17, and had no children. Up to two years previously she had always been healthy. She then began to complain of dizziness and of a constant roaring in her left ear. She presently lost the hearing entirely in this ear and began to suffer from

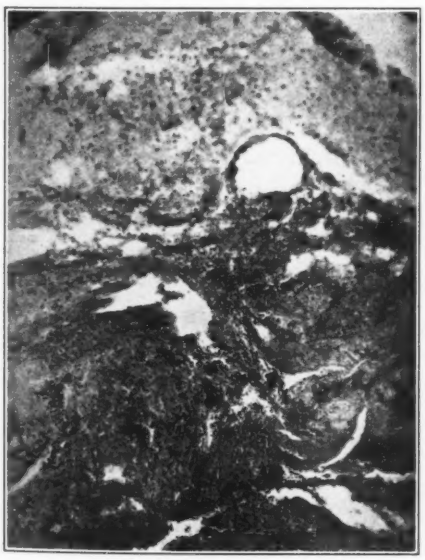

Fig. 9, Case 2
Section of the growth. Small cyst can be seen. Low power.

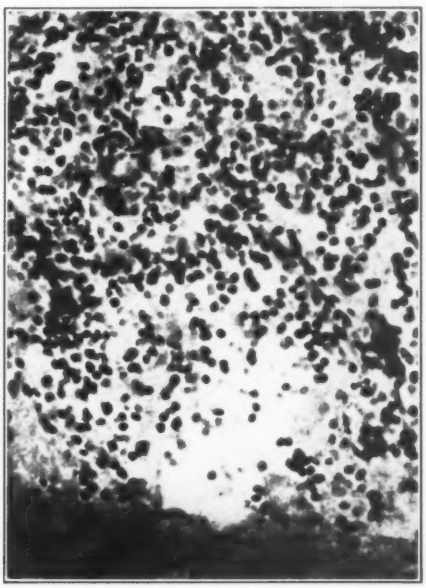

Fig. 10, Case 2
Medullo-blastoma. High power.

headache and attacks of dyspnea. Recently she suffered from attacks of nausea and vomiting. She had become so dizzy she could no longer walk alone. She staggered and fell, chiefly toward the left. She walked, even when supported, with her feet spread apart. She had what is known as a loose scalp, a beginning pachydermatocele (*Fig. 11*). She had lateral nystagmus on looking either to the left or to the right. Her eye grounds were normal. Her tongue deviated to the left. All reflexes were sluggish, the left more so than the right. On the caloric tests to the ears there was no pass-pointing, and no nystagmus when the left ear was irrigated. The tuning fork on the vertex was heard best with the right ear. The right side of her face was just a little stronger than the left, and her right grip a little weaker than the left. She held her head a little to the left, the left ear a little closer to the shoulder, the chin turned a little to the right.

There was no choked disc. The red blood cell count was 5,500,000, white count 8,600, hemoglobin 95 per cent, Wassermann and Kahn negative, urine negative, blood sugar 99, nonprotein nitrogen 34, blood pressure 110/88.

The headache, vertigo and vomiting pointed toward intracranial neoplasm. The peculiar gait and station and the obtunded reflexes pointed toward a tumor in the posterior fossa, the onset with roaring in the left ear, followed by left deafness, and the caloric test pointed toward tumor of the left acoustic nerve. It has been noticed that many such tumors have been in patients afflicted with von Recklinghausen's disease, of which the patient's loose scalp is a manifestation, and the diagnosis of tumor of the left cerebellopontile angle was made and an operation recommended.

On removal of the bone there was discovered bulging on the left side, and on lifting the dura a tumor about 3 cm. in diameter and nearly spherical, with three or four small tumors budding out, as it were, on its surface, each about the size of a pea, was found (*Fig. 12*). It had pushed out from the left cerebellopontile angle, displacing the cerebellar hemisphere downward and backward. The capsule of the tumor was incised and the tumor practically shelled out. She made a good recovery and returned to her home. Three months later she became ill again and was returned to the hospital. She was suffering from slight bronchitis, but we thought

Fig. 11, Case 3

Operated 1933. Patient still alive and well June, 1937. Tumor of the acoustic nerve. Note the folds in the scalp. The redundancy of the scalp is a frequent finding in von Recklinghausen's disease. This patient had some other signs, such as pigmentation and a few small tumors, but not a well marked case of von Recklinghausen's disease. Many of the acoustic tumors have been found in patients with von Recklinghausen's disease.

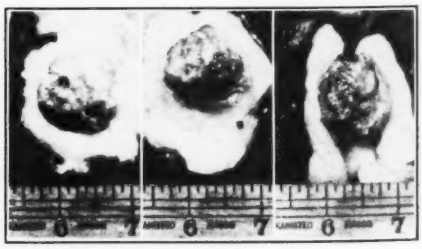

Fig. 12, Case 3

Three different views of the tumor removed. The photograph is poorly posed and the tumor is lying on a cotton fluff.

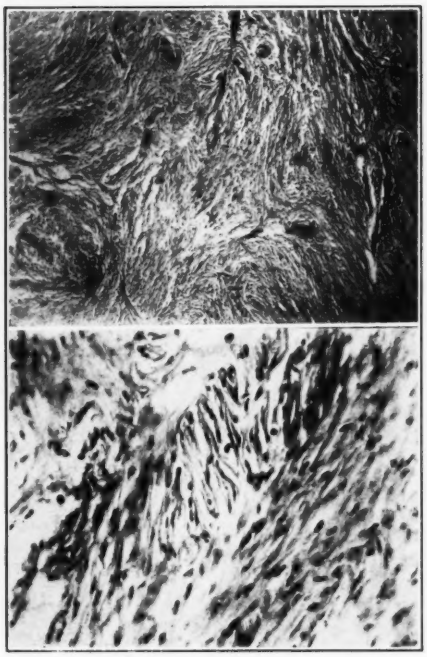

Fig. 13, Case 3

Tumor under low and high power, ordinary H. E. stain. Perineural fibroblastoma.

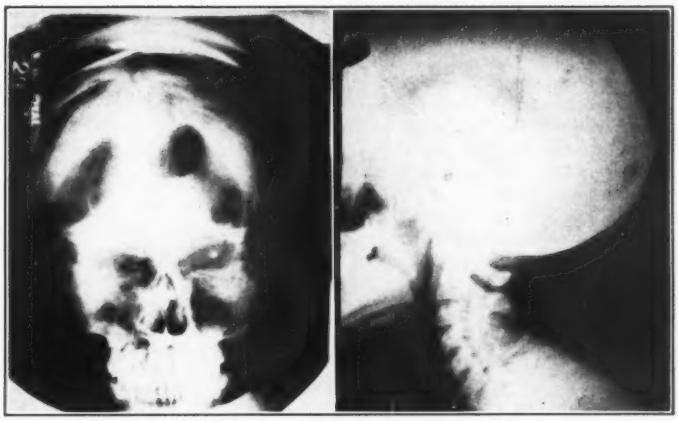

Fig. 14, Case 4

Operated 1934. Patient still alive and well June, 1937. Symptoms of brain tumor, but no localizing signs. Ventriculogram reveals marked hydrocephalus, both lateral and third ventricles.

her condition was due to the return of the tumor. However, it may have been due to her fever or to lack of proper food. She has been quite well now for more than two years.

The microscopic examination shows the characteristic picture of perineural fibroblastoma, the tumor of the acoustic nerve (*Fig. 13*).

Case 4.—R. P. (anesthetic, first avertin and ether, second ether, Firmin Deslodge Hospital, November, 1934), a boy of 15, high school student, four months before had been struck on the head by some books thrown at him. He did not lose consciousness; he did

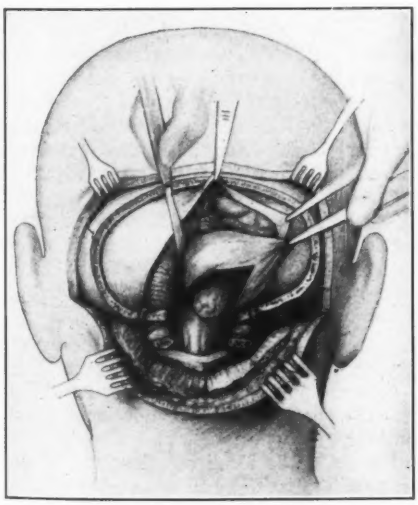

Fig. 15, Case 4

The artist's drawing of the condition seen at operation. A small tumor and a large cyst.

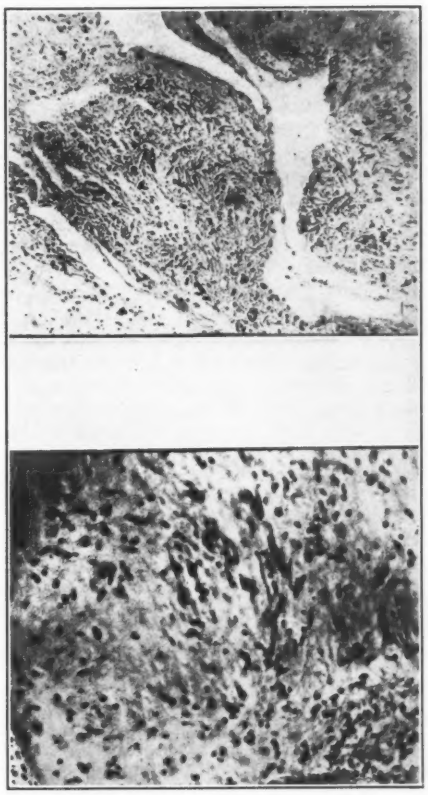

Fig. 16, Case 4

Sections of tumor removed from low and high power. Diagnosis: glioma arising from the ependyma?

not complain of headache until two weeks afterward. It had been constant ever since, severe frontal, right and left, and occipital. He had occasional vomiting, worse after lunch. At the onset vomiting was always preceded by pain in the epigastrium. Vomiting had always occurred without nausea. The headaches had always been made worse by exercise. His vision had been failing for over two months. His eyes hurt him. The conjunctivae looked red. He consulted an oculist, who discovered bilateral choked discs and called for neurologic consultation. He had been kept under observation for a month. He had attacks of very severe pain in the shoulders and chest.

A physical examination showed visual fields normal, ocular movements normal, no nystagmus, a slight conjunctivitis, choked discs, some bad teeth, enlarged tonsils. Heart and lungs were normal, blood pressure 118/75, and abdominal reflexes exaggerated on the right or diminished on the left. The face was symmetrical. The tongue protruded a little to the left, hearing and smell were normal. Caloric tests were all normal. The head was held normally. There was no stiffness of the neck. Finger to nose and heel to knee movements were normal. The toes of the right foot fanned slightly when the sole was stroked. Gait and station were normal. Wassermann and Kahn were negative. The red blood count was 5,000,000; white count 6,000, and the urine was normal.

He had been getting worse under observation and I was asked to do an air injection. This showed a very distinct dilatation of both lateral and third ventricles, with no air below the tentorium. Air injected into the spinal canal after the ventricular injection did not ascend into the skull (*Fig. 14*). The diagnosis was subtentorial tumor.

The operation was done in two stages, the second a week after the first. At the second operation the right hemisphere bulged more than the left. A cystic tumor was found, apparently replacing and extending into the fourth ventricle (*Fig. 15*). A complete cast of the latter (cystic mass) was removed with the tumor. There was a yellowish fluid in the cyst and it coagulated spontaneously. At the bottom of the cyst on the right restiform body was a solid, reddish, somewhat raspberry-like mass, 1 cm. in diameter. Part of it was removed and part of it was carefully coagulated. Microscopic examination showed a very vascular tumor with slit-like spaces in its formation, a glioma arising probably from the ependyma (*Fig. 16*). This patient also has received x-ray treatment. He has been well now two years.

The remarkable thing about this case is the scarcity of physical signs. The only positive physical sign was choked discs. The air injection in this case enabled us to make the diagnosis while there was yet a chance to save his life, before the glioma had invaded the floor of the fourth ventricle.

ROENTGENOLOGIC FINDINGS IN INTRACRANIAL LESIONS*

By C. H. Heacock, M.D., F.A.C.R.
and
Nicholas Gotten, M.D., F.A.C.S.
Memphis, Tennessee

The roentgen examination has become an invaluable aid to the neurologist and the neurological surgeon in his diagnostic problems. As a result of improvement in technic and better interpretation, the x-ray examination may determine not only the presence or absence of many intracranial lesions, but frequently determines the nature and exact location. Schwartz[11] found that 70 per cent of cases with intracranial disease showed some primary or secondary evidence of its presence on the roentgenogram. In about 30 per cent of his patients the lesion was accurately located by this method of examination. This large percentage of accurate diagnoses has been obtained chiefly in the large neurological clinics. Certainly, the same percentage, or at least an approximation of that percentage, can be obtained by the individual radiologist if certain rules are kept in mind.

The prerequisite for an accurate interpretation of roentgenograms of the skull is a good radiographic technic. The views necessary in patients suspected of having intracranial lesions should be stereoscopic films made in the lateral position, films in the anterior-posterior position, the posterior-anterior position, and in such other positions as are especially indicated. In studying these films, the roentgenologist should develop a systematic order. After a general first impression has been gained we prefer to study the tables carefully, then the sella, the floor of the skull, especially of the posterior fossae, and so on until all of the anatomy has been reviewed in some definite order. We believe that this routine examination should be made prior to any introduction of air as a contrast medium.

Intracranial disease gives its evidence in roentgen examination by local and general signs. The general signs are those of increased intracranial pressure, such as convolutional atrophy, separation of the sutures, and atrophy of the sella turcica. The localizing signs are calcifications, proliferations, local areas of erosion, in-

*Read in Section on Radiology, Southern Medical Association, Thirtieth Annual Meeting, Baltimore, Maryland, November 17-20, 1936.

creased vascularity, and displacement of the shadow of the pineal gland.

TABLES OF THE SKULL

By convolutional atrophy is meant the thinning of the inner table of the cranial bones due to the pressure of the cerebral convolutions. It requires increased intracranial pressure of fairly long standing to manifest these changes which are likened to the appearance produced by pressing the fingers in putty. They have no localizing value and may be due to a lesion far from the cranial vault. It should be remembered, also, that these areas of thinning may be normal. Davidoff,[4] in a study of 2,500 normal skulls, warns against regarding convolutional atrophy as pathologic, especially when found in premature skulls. In these premature skulls, separation of the sutures as a sign of increased intracranial pressure is a more constant and reliable sign.

Before the observer allows his attention to be diverted from the tables of the skull he should look for variations in density. In tumors arising from the meninges there may be no increase in intracranial pressure, but due to the irritating effect of a local growth there is an increased amount of calcium deposited locally in the cranial bones. The new bone formed is often spiculated, with the spicules arranged perpendicular to the planes of the tables. The areas show no tendency to be confined to one particular bone, as is likely to be the case if the process is not due to an intracranial tumor. These localized areas of increased density are spoken of as hyperostoses.

Another roentgen finding in the tables is often noted in cholesteatoma. These tumors usually occur in the mastoid antrum, but may be found anywhere in the skull. They are usually found in the diploe and produce an area of osteolysis with a surrounding zone of increased bone density.

SELLA TURCICA

No part of the radiograph should be studied more carefully than the sella turcica. Some changes in the sella occur in almost 50 per cent of all intracranial tumors, whether these lesions are localized in the pituitary fossa or elsewhere. The changes noted are: (a) alteration in size and shape, (b) erosion of the dorsum sella and posterior clinoids, (c) erosion of the floor, and (d) erosion of the anterior clinoids. The sequence in which the erosion occurs often aids in determining whether the cause is local or distant. As has been pointed out by Gershon-Cohen,[9] the floor is usually affected first in the intrasellar growths with encroachment upon the sphenoid sinus: the dorsum and the posterior clinoids are eroded later. If there is dilatation with pulsation of the third ventricle, in distant tumors this process is reversed and the posterior clinoids are thinned and eroded first, then the dorsum and finally the floor. The pituitary adenoma produces the greatest amount of destruction of the sella turcica (*Fig. 1*) and practically no other bone changes. The chromophile type causes less sellar destruction, but produces acromegaly and gigantism as an associated symptom-complex. The basophilic adenoma produces no changes in the sella because the tumors are microscopic in size.

POSTERIOR FOSSA

In studying the petrous portion of the temporal bone it is important to use the projection devised by Chamberlain and advocated by Bailey and Gotten.[1] This is an anterior-posterior view with the patient's head flexed and the chin drawn in so that the petrons are projected in profile. In this area the usual roentgen signs are areas of erosion and an increased size of one internal auditory meatus as compared with the other. These changes are produced by lesions, usually neoplastic, at the cerebellopontine angle. The neuromas and gliomas are the most frequent tumor type, but meningiomas and carcinomas occur in this area. The roentgen ray changes in these pathologic processes are chiefly confined to the perineural fibroblastomas and the meningiomas. A neuroma produces pressure erosion about the internal auditory canal, whereas,

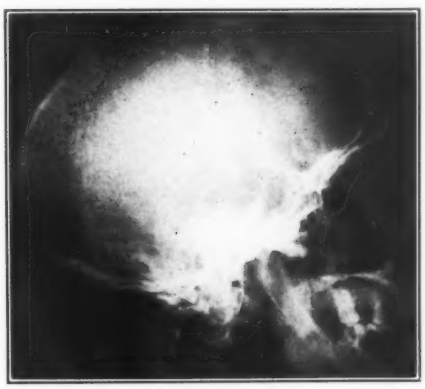

Fig. 1
Pituitary adenoma with erosion of sella, but no other signs of increased intracranial pressure.

Fig. 2
Calcification in the wall of a cystic tumor in the posterior parietal area.

a meningioma directly invades the bone and sets up a reactive hyperostosis. Bailey and Gotten[1] found erosion in eight out of nine cases of acoustic neuroma, whereas, lesions such as gliomas, multiple sclerosis and tuberculomas did not show erosion.

CALCIFICATIONS

Next, the entire cranial cavity should be studied for abnormal calcifications (*Fig. 2*). Some of these calcifications are physiological, such as calcification in the pineal body, the choroid plexus and the falx cerebri. The importance of recognizing these physiological deposits and not confusing them with deposits in neoplastic tissue cannot be over-emphasized. Calcification in the choroid plexus is especially confusing and is most likely to be misinterpreted unless the observer is familiar with the location of the choroid plexus and its appearance when invaded by lime salts. Calcification in the choroid plexus practically always occurs in the glomus and is bilateral. Anterior-posterior views show it 2.5 cm. lateral to the midline. In the lateral view it lies behind and above the shadow cast by a calcified pineal gland. The shadow is usually circular and rather faint. Davidoff and Dyke[5] have likened it to the appearance of a popped kernel of pop-corn.

The presence of calcium in new growths is probably the most reliable localizing sign of brain tumor. It was present in 7.7 per cent of Gershon-Cohen's[9] series of 221 tumors and 7.6 per cent of Camp's[2] series of 781 verified lesions of the brain. Calcifications are found in gliomas, endotheliomas, supra-sellar cysts, hemangiomas, dermoids, and cholesteatomas; but they may also be found in aneurysms and hematomas. Probably the highest percentage of calcification occurs in supra-sellar cysts. This was observed in 70 per cent of McKinsey and Sosman's[10] cases.

Tumors arising from blood vessels constitute about 2 per cent of all intracranial tumors and in 50 per cent of these, sufficient calcium will be present in the walls of the vessel to make them visible on the roentgenogram. The calcification is laid down in parallel lines which helps in the identification. True aneurysms are often encountered, most commonly along the circle of Willis and about the carotid arteries. When the aneurysm occurs on either side of the sella it produces unilateral erosion of the bone with deposits of calcium around the pituitary fossa. Calcification in hematomas is usually much more dense than that seen in neoplasms and has a tendency to be triangular in shape. In all calcification in intracranial tumors, we should remember that it does not give absolutely true information regarding the size and nature of the lesion.

Calcification in the pineal gland is very common after the second decade and was found by Dyke[7] in 51 per cent of 2,724 individuals in all decades. The value of the pineal shadow in the localizing of brain tumors was recognized as early as 1926 by Vastine and Kinney.[12] They devised an ingenious method of measurements and charts to determine the normal range of variation in the position of the pineal gland. By plotting a large number of measurements they were able to determine the normal limits of the displacements. Pineal shadows lying beyond these normal ranges may be regarded as due to displacement, most probably by an intracranial tumor (*Fig. 3*). In their series of cases the pineal shadow was found to be displaced in 51 per cent of the patients with gliomas, in 57 per cent of those with meningiomas, and in 22 per cent of those with acoustic neuroma.

SPECIAL EXAMINATIONS

No matter how carefully this preliminary study of roentgenograms may be, the examination is usually not complete and a diagnosis cannot be definitely established until further roentgen studies have been made with air as a contrast medium. Ventriculography, or the introduction of air directly into the ventricles, was first introduced by Dandy[3] and has been in common use since 1918. More recently, encephalography, or the introduction of air through a lumbar

Fig. 3
Displacement of the lateral ventricle, the third ventricle and the calcified pineal gland to the left by a tumor in the right cerebral hemisphere.

puncture needle, has had a somewhat wider use than ventriculography because of the lower mortality rate and the greater ease with which the examination is made. It should be stated that where the intracranial pressure is very high or where the lesion is in the posterior fossa of the skull, encephalography is probably more dangerous than ventriculography. In both, it is our routine to make horizontal stereo-roentgenograms in both right and left lateral positions, anterior-posterior and posterior-anterior views, as well as lateral views in the upright position. In this way, structures not shown in one position may be visualized in the other.

VENTRICULOGRAPHY

The diagnosis of lesions of the brain by ventriculography and encephalography requires not only a knowledge of cranial pathology, but a knowledge of the anatomy of the brain and of the circulation of the cerebrospinal fluid. The interpretation depends entirely upon changes in the size and position of the ventricles and the distribution of air over the surface of the brain. To draw accurate conclusions as to the size and contour of these cavities, it is necessary to have both ventricles completely filled with air. To obtain this, both ventricles should be punctured and air injected on both sides. Where ventricular puncture is used as the method of air injection, the diagnosis is made entirely upon changes in the size, shape, and the position of the ventricles, as little or no air is present on the cortical surfaces.

The ventriculogram study may be begun by examining the ventricles for lesions of the posterior fossa which may cause compression of the fourth ventricle or obstruction of the aqueduct of Sylvius (*Fig. 3*). Here one finds a uniform dilatation of the lateral and third ventricle due to the increase in intracranial pressure, and also one notes the absence of air in the fourth ventricle from direct obstruction. To insure that this absence of air in the fourth ventricle is due to obstruction and not incomplete filling,

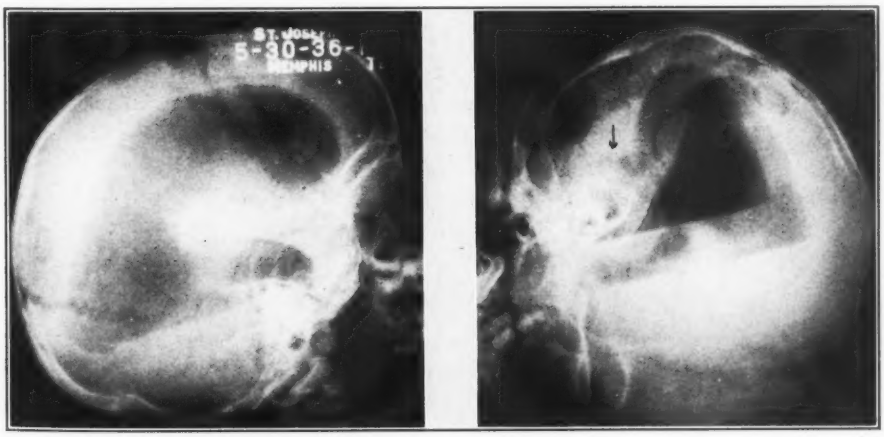

Fig. 4
This illustrates the filling of the fourth ventricle, indicated by arrow, when the face is placed in a dependent position.

it is important that a film be made with the head in the dependent position (*Fig. 4*). Lesions of the aqueduct of Sylvius, due to inflammation or tumors, may be impossible to differentiate from fourth ventricle or posterior fossae tumors. Where they are suspected, a combined ventriculogram and encephalogram is necessary. Injection of air into the ventricle, as well as the spinal canal may show the extent of the obstruction to the aqueduct of Sylvius (*Fig. 5*).

Tumors of the third ventricle give the most characteristic and easily recognized findings in ventriculography. There is usually evidence of dilatation of one or both lateral ventricles with no air in the third ventricle, or if air is able to enter a filling defect is visualized. Davidoff and Dyke[6] have demonstrated that this defect has a concave posterior border. Combined with these findings of obstruction and distortion of the third ventricle, attention should be directed to the basal cisterns beneath the third ventricle which are frequently obliterated by the tumor.

Lesions in the lateral ventricles of the brain are also manifested by either filling defects in one or both ventricles, or by changes in the position of these structures in relation to the skull, especially the midline of the skull. Tumors arising from the walls of the ventricles follow the line of least resistance and produce their greatest bulk within the cavity where they are clearly outlined by the injected air. Tumors in the neighborhood of the ventricles, but having their maximum bulk in the cerebral hemispheres, may cause a compression and obstruction of the ventricle with a shifting of all of the cavities toward the opposite side of the skull. Careful notation should be made as to which portion of the ventricle is compressed in order that localizations may be more exact.

Occasionally, one ventricle is pulled toward the surface of the brain, thus distorting the cavity by traction rather than pressure. This change is usually observed after trauma in which there has been an area of scar tissue between the brain and the meninges. The contraction of the scar tissue causes the ventricles to be distorted in this direction. The presence of old hemorrhages in the brain, both as a result of injury at the time of birth, or subsequently, may result in a unilateral dilatation of one ventricle (*Fig. 6*) or even porencephaly. The latter is due to atrophy or degeneration of the brain with a compensatory dilatation of the fluid spaces.

ENCEPHALOGRAPHY

All of these changes may be demonstrated by ventriculography or encephalography, inasmuch as both of these procedures cause a filling of the ventricles with air. A ventriculogram, however, will not give any information as to the condition of the cortex of the brain because the air does not surround the brain. When air is in-

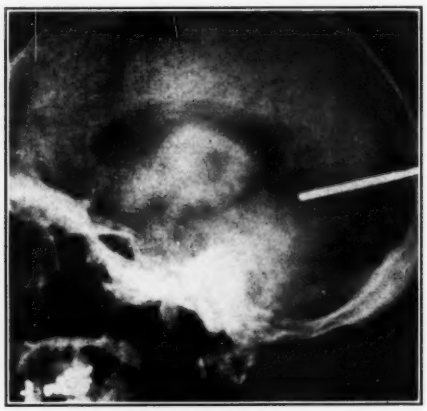

Fig. 5
Tumor of the fourth ventricle. No filling and abrupt termination of shadow of the aqueduct of Sylvius.

Fig. 6
Unilateral dilatation of the lateral ventricle as a result of severe trauma.

jected by the lumbar route as in encephalography, not only does the air completely replace the fluid in the ventricles, but it also displaces the fluid in all the convolutional pathways, thus showing additionally a pattern of the cerebral hemispheres. With this detailed visualization of the cerebral hemispheres, there has developed a wider use of encephalography in the diagnosis of neurological conditions. It can be of aid in differentiating brain atrophy, post-traumatic encephalopathy, epilepsy, birth trauma, and degenerative diseases, as well as in tumors.

Davidoff and Dyke[8] have discussed thoroughly the normal cerebral structures evidenced by air injection. Certainly, these normal air patterns must be known with the same familiarity as the normal skull markings before a proper interpretation of the changes can be made. Air markings noted in encephalography on the cerebral surfaces are shadows produced by the replacement of fluid in the sulci. The size and position of these shadows in comparison with the normal lines determines the extensiveness of the disease. Certain of these sulci uniformly present in normal cases may be absent under pathologic conditions. As has been pointed out by Davidoff and Dyke,[8] four sulci on the mesial surface of the brain are normally visible in the encephalogram. These are the collosal, cingulate, parieto-occipital, and calcarine sulci. On the lateral aspect of the brain the pattern is much more complex, but it has been established that most of the brain sulci are visible if the radiographs made in the various positions are studied. These are: (a) the fissure of Sylvius, (b) the island of Reil, (c) the temporal lobes and sulci, and (d) the central, frontal, and posterior sulci of the cerebral hemispheres.

The shadows produced by the choroid plexus of the lateral ventricles should be recognized. The choroid occupies the grooves between the basal ganglia and the thalami of the ventricular floor. It is observed in approximately 50 per cent of encephalograms. The normal choroid defects, according to Davidoff and Dyke,[5] are located at the junction of the occipital and temporal horns with the body of the ventricle and from a smooth concave notch in the inferior portion of the body of the ventricle.

As has been stated before, the chief advantage of encephalography over ventriculography is in differentiating neurological conditions that involve the cerebral hemispheres of the brain. The conditions which affect the topography of the cerebral hemispheres are brain tumors, scars of the cortex, adhesions of the arachnoid, chronic infections, epilepsy, degenerative conditions, such as Tay-Sacks disease, mental deficiency, and, in some instances, mental disorders (*Fig. 7*). The filling defects that take place in the ventricles in encephalography have already been discussed with ventricular defects.

The ventricular changes in ventriculography and encephalography are identical. One frequently observes air in the ventricles, in the cisterna pontis and magna, but it fails to reach the cisterna chiasmatis and consequently there is no air over the vertex. Obstructions of this nature may be due to neoplasms, but are most frequently noted in brains that have been affected by trauma or disease. As a result there is a back pressure and a secondary hydrocephalus. The examination of the surface of the brain in encephalography is a study of the fluid patterns. A routine should be followed in which an attempt is made to identify the various sulci or fluid pathways that are normally seen following air injection. Inflammations and hemorrhages will cause adhesions of the arachnoid so that these pathways may be partially or completely obliterated. This condition may be present on one or both sides and there may be compensatory dilatation of other sulci. Tumors of the brain produce obliteration of the pathways due to the fact that the increase in size of the cranial contents presses upon the fluid spaces. The differential diagnosis in these conditions from inflammatory change is aided by the ventricular patterns as well as by the history of the case.

Fig. 7
Tay-Sack's disease with marked cerebral atrophy and increase in the air spaces.

SUMMARY

In conclusion, it may be said that intracranial lesions produce changes that are demonstrable upon the roentgenogram with about the same constancy as do intra-thoracic and intra-abdominal lesions. Our ability to interpret these changes is directly proportional to our knowledge of the anatomy of the skull and the brain, and the pathological characteristics of the lesions of these two important structures.

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DISCUSSION (*Abstract*)

Dr. Carrol C. Turner, Memphis, Tenn.—Not too much stress can be given to the importance of the proper interpretation in roentgenologic studies of intracranial lesions. Drs. Heacock and Gotten refer to a series of cases studied by this method in which 70 per cent of cases with intracranial disease showed definite evidence on x-ray films. In about 30 per cent of these the lesion was accurately located by this method. This and similar series have been obtained chiefly in the large neurological clinics. The proper interpretation by x-ray of intracranial disease requires an intimate knowledge of the architecture of the normal skull and its contents as well as a thorough familiarity with the deviations from normal of these structures. Otherwise it is necessary for the x-ray man and neurologist to work cooperatively in order for either to attain full information to be derived from x-ray studies of intracranial disease.

Encephalography has become more and more a popular procedure among neurologists and neurosurgeons. Air is as safe an opaque medium to the x-ray as can be introduced into the ventriculo-subarachnoid systems. There are few conditions in which the ventricles cannot be visualized by this method. The procedure is safer than ventriculography and requires no surgical risk. Not only ventricles are visualized, but also the basal cysterns and cerebral cortex. In situations in which the chiasmal cystern vent is blocked, no air can get through to spread out over the cortex, in which case the subtentorial spaces and ventricles only are visualized by air introduced from below. In situations in which the appertures of the fourth ventricle are sealed off or the ventricular space obstructed, the air spreads out over the cortex, but the ventricles are not aerated. In such an instance ventriculography must be combined with encephalography. As Drs. Heacock and Gotten have brought out in this paper, pneumography should proceed only after thorough roentgenological studies of the skull have been systematically done.

Pneumography is also a valuable adjunct in neurological studies other than in suspected massive intracranial pathological conditions. In arteriosclerotic degenerations, paresis and other conditions in which the whole or part of the brain structure is shrunken, encephalography gives its evidence by excess accumulations of air over the atrophied cortex. In chronic piaarachnitis, subdural hemorrhage and subarachnoid hemorrhage, absence of air over the cortex is a valuable diagnostic finding.

Introduction of air into the ventriculo-subarachnoid systems is also of therapeutic benefit. It may break up cortical adhesions such as exist in traumatic epilepsy. It has been known to dislodge fibrin plugs, serving to block the cerebral aqueduct and it may be of benefit in some of the acute psychoses, resulting from chronic cerebral anoxemia.

CORRECTION OF DEPRESSED DEFORMITIES OF THE EXTERNAL NOSE WITH RIB GRAFT*

By LEE COHEN, M.D., F.A.C.S.
Baltimore, Maryland

In the field of corrective rhinoplasty study of the etiology and correction of depressed deformities of the external nose has always presented many intricate and interesting problems. Such deformities include not only saddle noses of the congenital type, which actually make up the smaller number, but also single and multiple dorsal depressions which follow injuries of the external nose. Then, too, we have those depressions of the dorsum resulting from loss of septal support, owing to a destruction of the cartilage by septal abscess, or when the triangular cartilage has been too extensively removed in performance of a submucous resection. These last mentioned depressions are confined to the cartilaginous nose, whereas the others may involve either the bony dorsum alone, or both the bony and cartilaginous portions.

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*Read in General Clinical Session, Southern Medical Association, Thirtieth Annual Meeting, Baltimore, Maryland, November 17-20, 1936.

Whether the depression is confined to the bony or cartilaginous dorsum alone, or whether the dorsal plane of both portions has been disturbed, is *ipso facto* of prime importance in determining the shape of the graft necessary for correction. In every case, however, a straight dorsal plane is the result desired, and this can be obtained only when the graft extends in a continuous plane from the frontal notch above almost to the tip of the nose below, with periosteum and perichondrium left undisturbed on its upper surface. All alterations in the shape and thickness of the graft, to make it conform with the deformity of the underlying nasal dorsum, must therefore be made from the under surface of the graft (*Fig. 1*).

To obtain an ideal result, the width of the graft is of the utmost importance and, unless great care is exercised, an unduly wide nasal dorsum will result. The graft should always be narrower at the upper bony end, where it contacts the nasal notch, than at its lower cartilaginous end, in order to conform with the usual pyramidal shape of the nose. Generally speaking, the upper end of the graft should be from one-eighth to three-sixteenths of an inch wide, while its lower cartilaginous end should not exceed from three-sixteenths to one-quarter inch in width. Both upper and lower ends of the graft should be beveled from the under surface.

Fortunately one hears but little these days about the use of ivory and celluloid implants. While such foreign substances may be retained for a variable length of time, with apparently excellent cosmetic results, one never knows when the human tissues, because of lowered resistance, will refuse longer to tolerate the presence of these foreign bodies. Such intolerance of the tissues, with ensuing suppuration, necessitating removal of implant, has been often enough observed completely to discourage the use of any foreign substance for implants. The autogenous graft from the rib is now conceded by surgeons doing most of this work to be the safest and most enduring.

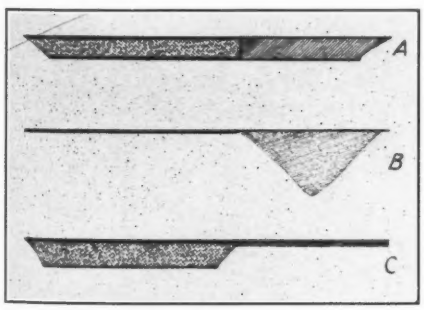

Fig. 1

Schematic. Indicating several forms of rib implant showing use of full rib thickness outer table only with costal cartilage shaped to fit depression and whole thickness of rib with thin layer of costal cartilage extending to tip of nose.

In rhinoplasty, however, there is still some difference of opinion as to whether an all costal cartilage graft, or one composed partly of rib bone for its upper portion, where it contacts the nasal bones, and cartilage for its lower portion, is the better. Time will not permit of a detailed discussion of this mooted point, but suffice to say that, in an experience of over twenty-five years we find only the bony portion of a graft will ever fixedly unite with the underlying nasal bones, and that our results with the mixed graft have been so universally satisfactory we never entertain an idea of making use of any other type of graft.

Before sending a patient to the operating room all hair is removed from within the nares, and the nose is thoroughly irrigated with sterile normal salt solution. The interior of the vestibule is then carefully cleansed with ether and alcohol and left packed with cotton pledgets saturated with 70 per cent alcohol until anesthesia is complete. A postnasal pack is now inserted, to prevent blood from reaching the pharynx and trachea, and the nose securely packed with sterile gauze tape to shut off completely the operative field in the vestibule from the mucous membrane lined nasal cavity. Then after the face is so draped that a contamination of the nasal wound from the mouth is not likely, we are ready to proceed with the operation.

We first prepare the nose for reception of the graft through bilateral intranasal incisions along the margin of the pyriform opening. These incisions extend from beneath the dorsum nearly to the root of the nose. While a unilateral incision might be sufficient for introduction of the graft, we find that unless bilateral incisions are made, subsequent scar tissue contraction tends to draw the nasal tip from the mid-line toward the side in which the incision is made. The vertical incision through the columella, advocated by some operators, has the disadvantage of leaving an external scar. Only very recently we saw an ugly contraction following such an incision, with a disfigurement which can never be completely overcome. There can be no doubt that infection following a columella incision from the nasal secretions, with resultant disfigure-

ment, is more likely to ensue than when the intranasal incisions are employed.

Through these alae incisions the skin over the entire body dorsum can be easily undermined with a small tenotomy knife. Then, with a knife blade half the length of the small tenotomy knife, the point directed toward the tip of the nose, a pocket may easily be prepared for the lower cartilaginous portion of the graft. This pocket must be made beneath the thin fibrocartilage that makes up the framework of the mobile nose. Any attempt to separate this fibrocartilaginous layer from the overlying skin will be followed by contractions which later seriously disturb the normal contour of this portion of the nose.

Most essential in preparing the nose for reception of the graft is completely to denude, with rasp and periosteal elevator, the periosteum from the summit of the bony dorsum, with special attention to the region of the nasal notch. Thus, denuded bone is placed in contact with denuded bone. If this procedure is meticulously carried out, firm union between the rib and the underlying nasal bone is certain to follow, provided the graft is held firmly and in intimate contact with the nasal dorsum, by means of some sort of saddle splint. We have of late substituted thin semi-hard sheet aluminum for the sheet copper formerly employed in making these saddle splints. Aluminum is lighter in weight, and we find it especially desirable during the warmer months, as it does not retain the heat and cause skin maceration occasionally seen in using the copper splint.

This bony union between the graft and the nasal dorsum is absolutely essential for the life of the graft. Without it nutrition of the graft is faulty and gradual absorption is sure to follow: whereas with such union the graft becomes an integral part of the bony framework of the nose and will never be absorbed. This is amply demonstrated through a number of cases operated upon so long ago as 25 years, still observed, with grafts in perfect state of preservation.

If, in addition to the dorsal deformity the nose is laterally displaced, as not infrequently occurs following marked trauma, we prefer a two-stage operation. The scoliosis is first corrected, and from six to twelve weeks are allowed to elapse before the rib graft is done, as the life of the graft might be endangered through infection by placing it in a field too greatly traumatized. On this account also we never insert a rib graft in a field traumatized by the injection of procaine hydrochloride, but always employ ether anesthesia. For all other types of rhinoplasty, however, we use local anesthesia.

Since bony union is the *sine qua non* in the prevention of graft absorption, we never introduce cartilage without bone in the correction of a dorsal depression, not even where the bony dorsum is perfect and the depression wholly restricted to the cartilaginous portion. In such instances, the outer table of the rib, made as thin as possible by removal of all diploic structure along with the inner table, is left attached to the costal cartilage, which may be given any desired shape to fill in the depression of the lower dorsum, where it is held immovable by the bony union above.

Wherever feasible, to augment precision in shaping the graft, we like to make a wax impression of the dorsal deformity prior to operation. From this wax impression a metal model is made, to be boiled with the instruments at the time of operation. After the field has been prepared for reception of the graft, this metal model may be slipped into place beneath the skin, to determine with more accuracy the shape and thickness of the rib graft required for the best possible correction. When the nasal field is ready for reception of the graft, all bleeding beneath the skin is stilled by firm but gentle pressure with a pad of gauze held over the dorsum of the nose by the assistant.

The operator now changes his gloves and gown, while the second assistant exposes the right side of the chest, previously prepared with ether, iodine and alcohol, and properly draped for operation. Through a curvi-linear incision, the seventh or eighth rib is exposed over the junction of the costal cartilage and bone (*Fig. 2*). A small strip of sheet metal, of desired length and width for the graft, is placed in the center

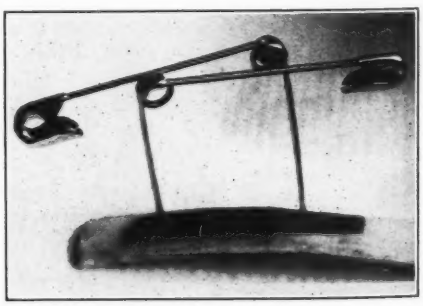

Fig. 2

Showing metal strip held on the center of rib with safety pins preparatory to incising periosteum as indicated in text.

of the long axis of the rib, to which it is held by means of two safety pins passed through perforations made with a dental punch near each end of the metal strip. A third perforation in this metal strip, about two-fifths of the distance from the broad end, is placed directly over the osseo - cartilaginous junction, to determine the proportionate length of the bony and cartilaginous parts of the graft.

Now, with the scalpel, the periosteum and perichondrium are incised along the edge of the metal strip, while directly at the ends of the strip these membranes are incised across the rib from border to border. Thus the actual width and length of the graft, as well as the length of the rib section to be removed, is outlined (*Fig. 3*). That portion of the nutrient membrane on the outer face of the rib, beneath strip, is left *in situ*. We proceed, with the periosteal elevator, to separate entirely the periosteum and perichondrium from the rest of the outer surface of the rib section. This separation is carried over the upper and lower borders until the membrane is also entirely separated from the inner surface of the rib; and so all the nutrient membrane of the rib section, except that small portion which covers the actual part to be used as a graft, is left in place. Leaving the nutrient membrane thus intact serves a dual purpose: first, by working external to the periosteum and perichondrium, all danger of accidental injury to the pleura is obviated, and secondly, regeneration of the portion of the rib removed, if the subject is not too old, is thus assured. We have observed rib regeneration in two individuals where incisions in the chest wall were made about one year later .

Our rib section having been removed with rib shears, to save time, closure of the chest wound is left to the assistant, while the operator proceeds to shape the graft, preparatory to its introduction within the nose. Narrow sharp chisels and bone shears are used to cut the bone, the scalpel being used for the cartilage. Those who make use of costal cartilage only, claim that difficulty in shaping the bone is too great. We find absolutely no difficulty in giving the desired shape to the bone by the method here indicated.

As a precaution against infection, which is admittedly more likely to occur with bone than with costal cartilage, we handle our graft only with bone forceps and gauze, never touching it even with the gloved fingers from the time it is exposed until planted. Only once, about 20 years ago, were we obliged to remove a graft because of infection. After the graft is shaped, ready for introduction, it is placed within a long beaked speculum (modified Killian's speculum for rhinoscopia media, *Fig. 4*) with which it is introduced through the left nasal incision all the way up to the nasal notch. Pressure of the speculum upon the graft is now released by a few turns of the set screw, the graft held in place with rat tooth forceps, and the speculum withdrawn. The lower cartilaginous end of the graft may now be manipulated and brought into the pocket near the tip of the nose, and the wound of both vestibules closed with several black silk sutures. Any attempt to introduce a rib graft without the protection of such a speculum is likely to result in loss of the graft through fracture. Besides, the graft cannot be safely introduced in any other way without added danger of infecting the bone through contact with the wound edges.

When the graft is in place, to prevent it from

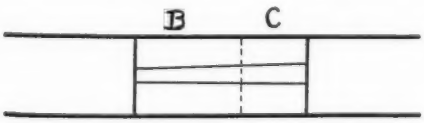

Fig. 3
Schematic. Showing rib section with outline of graft in center.

Fig. 4
Schematic. Graft on bridge of nose, with cartilage implant in septum for support.

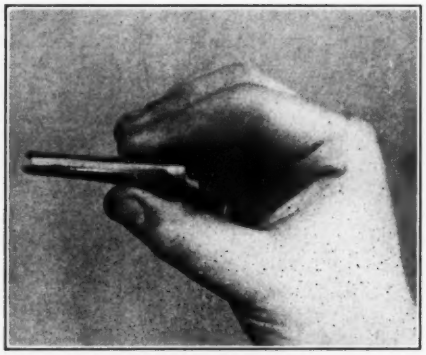

Fig. 5
Rib graft held in speculum, ready for introduction within the nose.

turning on its edge, it must be continually held by the thumb and index finger of the left hand of either the operator or his assistant, placed over the skin of the nasal dorsum, throughout all further manipulation.

In some cases, where complete destruction of the septal cartilage follows abscess, it is necessary to furnish support to the lower end of the dorsal graft (*Fig. 5*). This support is best supplied by placing a quadrilateral plate of costal cartilage between the two layers of septal mucoperichondrium, through an incision of the left side of the septum similar to that made for regular submucous resection. This plate of cartilage, from 2 to 3 mm. thick, is so placed that its lower front edge is supported by the anterior nasal spine, while its upper edge rests against the under surface of the dorsal graft. This cartilaginous plate may be removed, with scalpel, from the outer surface of the same rib from which the dorsal graft has been obtained. If, however, insufficient costal cartilage of this rib remains, it may be removed from the adjacent costal cartilage, without in any way weakening the chest support. The perichondrium is left on this plate of cartilage, but to prevent its curving toward the perichondrial covered surface, several transverse incisions from edge to edge, about 6 to 8 mm. apart, must be made through the perichondrium.

This septal support is inserted immediately after placing of the dorsal graft, and the septal incision is closed also with black silk sutures.

The nasal vestibule is now packed with one-half inch iodoform gauze tape and the saddle splint applied. Packing within the vestibule is generally removed on the third day after operation, but the splint is not disturbed for seven days; at this time skin over the nose is cleansed with 70 per cent alcohol, the splint is relined and applied for another week. Stitches within the nose and those of the chest wall are removed on the seventh day. All dressings of the nose are entirely omitted usually at the end of the third week.

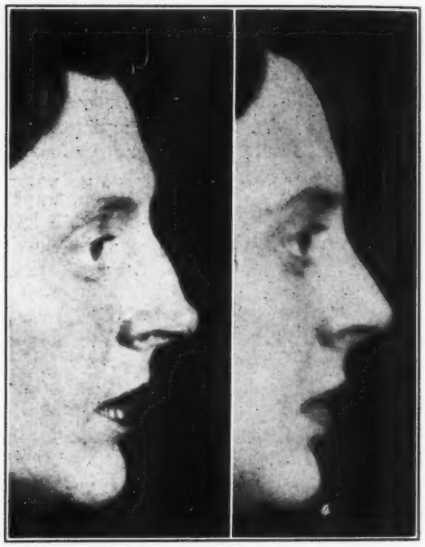

Fig. 6
Before operation. After operation.

Fig. 7
Before operation. After operation.

Fig. 8
Before operation. After operation.

In closing the wound of the chest wall we insert a split rubber drain of one-eighth inch Dakin tubing, from the lower end all the way to its upper end, to permit escape of serum, which is quite copious for twenty-four hours, when the tube is removed. Thus far we have never had an infection in our side wounds, nor have we seen a chest complication of any sort.

Our rhinoplastic cases of other types usually leave the hospital on the fifth day, but rib graft cases are kept eight or nine days. While some pain in the chest on deep inspiration, during the first 48 hours only, is complained of, an occasional hypodermic of morphine keeps the patient quite comfortable, and bathroom privileges are permitted on the fourth day. Complaint of pain in the nose is an extreme rarity.

In closing, I shall show you some few slides of various types of depressed deformity, with results obtained. Some of these cases have already been shown, but being extreme types they better illustrate the points discussed.

Mrs. L. S., aged 28 (*Fig. 6*) following a plastic operation in April, 1934, was unable to breathe properly through the nose. This was probably due to a pre-existing deflection of the septum, which became more obstructive following irritation and trauma induced by the plastic. Three weeks following the plastic operation a submucous resection was performed. A depression of the nasal dorsum followed this operation. In January, 1935, she returned to her surgeon, who placed an ivory implant on the dorsum of the nose to correct the depression. On the photograph, it can be seen that this ivory implant did not reach from the frontal notch to the tip of the nose, consequently there still remained a depression just above the tip. Besides this, pressure of the implant against the skin caused a continual redness of the skin which was accentuated with the least exposure to cold. In October, 1935, she came to us. The ivory implant was removed and a mixed graft of rib bone and cartilage was inserted with highly satisfactory results.

Mrs. J. S., aged 55 (*Fig. 7*), at the age of 2 had an abscess of the nasal septum, due to infection resulting from introduction of a shoe button in the nose. In 1924, a graft of rib cartilage was inserted by a surgeon in another city. Suppuration ensued, forcing its removal three days later. In 1929, a mixed rib bone and cartilage graft was inserted by us, using the outer table only over the bony dorsum with cartilage of sufficient thickness and proper shape for the lower two-fifths. An intra-septal implant of cartilage to support the lower end of the dorsal graft was inserted at the same operation, with very satisfactory results.

Miss J. E., aged 18 (*Fig. 8*), had had saddle nose since birth. In April, 1934, a mixed bone and cartilage rib graft was inserted. The entire thickness of bone was used in this case.

1820 Eutaw Place

THE CHOICE OF BONE GRAFTS IN FRACTURE SURGERY*

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Bone grafts in fracture surgery are used in the majority of cases for non-union in long bones. Occasionally, sliding grafts may be employed in order to obtain more perfect apposition of the fragments in cases that are as yet not classed as non-union, but are cases of potential non-union. In our experience, cases vary as to the relative importance of the mechanical as compared to the osteogenetic assistance. That is to be expected in using a particular type of graft. Therefore, the types of bone grafts to be considered are:

(1) Osteoperiosteal
(2) Massive onlay
(3) Massive inlay
(4) Intramedullary

The osteoperiosteal graft has been discarded practically in our clinics because of failure of securing mechanical stability following its use.

Briefly, non-union of the mid-shaft of the long

*Read in Section on Bone and Joint Surgery, Southern Medical Association, Thirtieth Annual Meeting, Baltimore, Maryland, November 17-20, 1936.

bones is treated as follows: the humerus, massive onlay graft; radius and ulna, massive onlay graft; neck of the femur, peg graft; shaft of the femur, intramedullary autogenous bone graft; shaft of the tibia, autogenous inlay graft; non-union of the malleolus, autogenous peg graft.

The massive onlay graft as described by Campbell is the graft of choice in cases of non-union following fractures in the shaft of the humerus and fractures in the shaft of the radius and ulna. Its value is attributed to excellent stability, plus a large area of new bone surface which is conducive to early callus formation.

In applying the massive onlay graft to the shaft of the humerus which has been flattened by the chisel above and below the fracture line, the amount of bone contained in the graft is considered as additional strength during the healing period and results in a permanent increase in the size of the bone over a distance of four to five inches. The graft is held in position by autogenous bone pegs which have been removed from the tibia at the time of removal of the graft proper. Usually three holes are drilled through the graft and shaft of the humerus above, and three drilled below the fracture line. As the drill point is removed, an autogenous peg is driven into place. These are considered as autogenous bone nails. The graft is also stabilized by using four double chromic catgut sutures. As the last step, a considerable amount of cancellous bone, which may be scooped out of the upper tibia, should be packed around the fracture area. A plaster shoulder spica is applied which must be efficient as an external splint because bone grafts tend to

A B C D

Fig. 1

A-B. Anterior-posterior and lateral views of ununited fracture of middle third of humerus, fourteen months' duration. Patient aged 42. Note that there has been no effort at callus formation.

C-D. Lateral and anterior-posterior views, nine months after successful massive onlay graft.

Fig. 2

Non-union at junction of lower and middle third, shaft of humerus. Flail arm for two years. Successfully treated by removal of Parham bands and application of massive onlay bone graft.

A B C

Fig. 3

(Same case as Fig. 2)

A. Showing two Parham bands that have been dislodged with a resulting non-union.

B. Failure after first bone graft, because of bone atrophy and difficulty of proper approximation of fragments.

C. Bony union after second massive onlay graft.

atrophy in the first weeks following application and are easily broken if any degree of strain is placed upon them before sufficient callus has been deposited.

The x-ray tells us when callus is adequate for removal of the plaster which, in the average case, varies from ten to sixteen weeks.

In the three failures we have had following the application of the massive onlay graft of the humerus, there had been previous operations. In one, two Lane plates had been introduced at the same time and had become loose, as well as all the screws, which had resulted in bone atrophy. In the second case, a Lane plate had been applied and later removed. In the third case, two Parham bands had been used in the oblique fracture of the lower humerus. The bands had become loose and one was holding the fracture fragments apart. In each of the three cases, the first onlay graft was unsuccessful for the same reason, extreme atrophy of the bone structure.

Two of the three were reoperated after union of the first graft to the humeral shaft had been obtained, which made the field of the second operation much more favorable. In one, we have obtained solid union. In the second, we have every reason to believe that we will obtain good union from the present condition of the bone as shown by the x-ray. The third case refused a second operation, but in that one the fracture fragments are in such excellent condition that the chance for successful grafting is good.

Solid union following this operation can be expected in a very large per cent of cases, providing the patient has had no previous operation or has had no marked loss of bone following infection.

In cases in which non-union has resulted from metal internal fixation, it is advisable to remove the metal and denude the end of the bone frag-

A B C

Fig. 4

A. Non-union of darius, following use of Parham band.
B-C. Solid bony union following autogenous bone graft, massive onlay type, taken from tibia.

A B C

Fig. 5

A. Non-union of lower ulna.
B. Sliding graft which was maintained by two small steel wires.
C. Solid union. Picture taken immediately after removal of wire (local anesthetic).

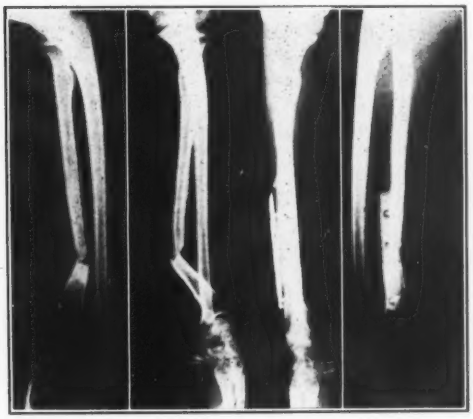


Fig. 6

Non-union, with malposition of lower radius. This case had been previously operated upon, therefore, this time, a heavy onlay bone graft was used with successful result.

ments at a preliminary operation, then later apply the massive onlay graft.

Non-union of fractures of the radius and ulna should be treated, at least in the majority of cases, by the massive onlay graft, using the same technic as described for non-union of the humerus. Occasionally, a simple non-union without loss of bone, or marked displacement of the fragments, may be treated by using a sliding inlay graft which is maintained by stainless steel wires; these may be easily removed by local anesthetic as soon as satisfactory union has occurred. It is not advisable to use sliding grafts on both bones of the forearm at the same operation, because sliding grafts have very little strength.

A B C

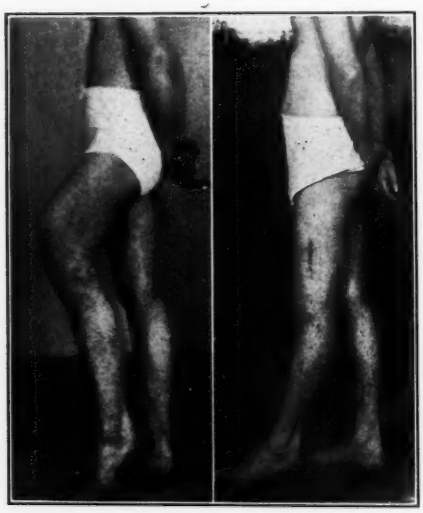
Fig. 7

A. Non-union of shaft of femur, one year's duration.

B-C. Showing both views of femur after union which resulted following the intermedullary tibial bone graft.

In a case where we attempted this operation, the inlay graft broke early and we later had to do a massive onlay graft which was successful. It must be noted here that a massive onlay graft of both bones at the same time is a most difficult operation and, if possible, it is better to postpone this procedure until one of the bones has united.

Following the application of the graft, external fixation is maintained by heavy molded plaster splints extending from the axilla to the base of the fingers. This type of fixation is better than a solid cast, as proper tension can be maintained over several weeks without changing the splint. If constriction must be relieved within the first few hours after operation, it is a simple procedure to cut the gauze bandage which maintains apposition of the splints; and, after the swelling recedes and atrophy increases, the splints may be brought closer to-



A B

Fig. 8

A. Extreme mal-union of shaft of femur, with anterior bowing.

B. Showing correction after autogenous intramedullary graft has been used.

A B C

Fig. 9

(Same case as Fig. 8)

A. Typical mal-union.

B-C. Both views of same case after correction, showing intramedullary graft with perfect apposition, alignment and union.

gether and adequate fixation carried out by changing the gauze bandage.

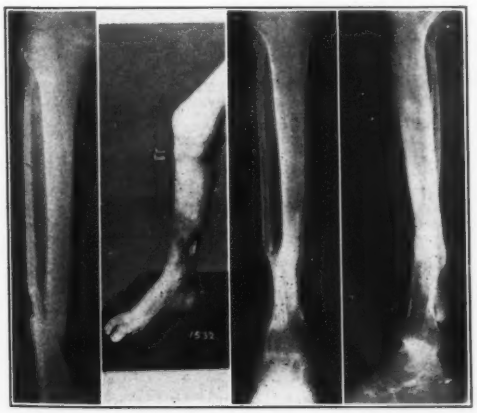
In non-union through the neck of the femur, an autogenous peg graft is advisable, providing the patient is in good general condition and is not too old to be considered a good surgical risk.

The technic of removing the tibial graft is easier in that the tibia is far more accessible than the fibula. Removing a portion of the entire shaft of the fibula is far more difficult because of the depth of the operative wound and the extent of heavy muscle attachments. The tibial type is the one used in our clinic.

Non-union of the shaft of the femur is best treated by intramedullary autogenous bone pegs removed from the tibia of the same leg. An inlay or onlay graft procedure of the femur is very difficult and somewhat dangerous in that the operation usually requires from two and a half to four hours. Postoperative deaths are not unusual in operation on the femur requiring this much time. Infections are also more likely where the living tissue is subjected to intense trauma.

The intramedullary graft is not considered advisable for physiological reasons, but its use in cases of non-union of the femur has been most satisfactory because it is by far the best method of obtaining perfect mechanical apposition. And, it has long been known that non-union of the femur practically never occurs in cases in which apposition has been maintained. The blood supply is far better than in the mid-shaft of the humerus or of the tibia.

The operation consists of removal of a large, long graft from the tibia which is inserted into the medullary canal of one fragment. Then, after the fragments are placed in direct apposition, the graft is worked down into the other fragment.



A B C D

Fig. 10

A. Non-union of two years' duration, compound fracture. Sinus had been healed eleven months.

B. Photograph of leg just before operation.

C-D. Shows bony union after inlay graft six months after operation. In this case operation was followed by a flare-up and wound drained about twelve weeks. Despite drainage, union occurred.

A B C D

Fig. 11

A. Non-union of tibia, right leg.

B. Amputation of left leg.

C. Correction of deformity, but failure to obtain union at first operation.

D. Successful result, after the fibula from stump of amputated leg had been used as autogenous intramedullary graft.

A B C

Fig. 12

A. Typical Pott's fracture with non-union of internal malleolus.

B-C. Solid bony union, following the use of two autogenous bone graft pegs which were removed from the same tibia at the middle third.

External fixation is maintained by the application of a plaster spica extending from the margin of the ribs to the toes on the affected leg and to the knee on the unaffected one.

Non-union in the shaft of the tibia is usually treated by the classical sliding inlay graft which was described by Albee many years ago. The results are most satisfactory because the tibia assumes almost normal contour after healing has taken place. The onlay graft placed over the flat surface of the tibia produces too much bone which may result in tension on the skin of this area and a potential area for frequent soft part injuries. In cases of extreme atrophy of the bone, the sliding graft may not be advisable, as soft bone does not result in adequate internal fixation. Therefore, it may be thought best to remove the graft from the opposite leg, even though an inlay type is to be used. Refracture of the tibia is not unusual should weight-bearing be allowed too soon, especially in cases where the fibula has not united. A long walking splint is advisable after removal of the cast to protect any postoperative bone graft operation of the tibia.

In cases of non-union of the internal malleolus following the Pott's fracture, one or two autogenous bone pegs are used for internal fixation.

INTRACYSTIC PAPILLOMA AND PAPILLOCARCINOMA OF THE BREAST*

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and
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This paper deals with a study of the intracystic papilloma and papillocarcinoma of the breast and the transformation of the first into the second.

Papillomata in cysts have been recognized since Velpeau, in 1838, and Sir Astley Cooper,[1] in 1845, first described cysts of the breast. The larger contributions to this subject have been made by Clopton,[2] Bloodgood,[5] Cheatle,[9] Hart[12] and Cutler.[14] They are agreed that these lesions occur shortly before or shortly after the menopause, in the last part of the fourth and early part of the fifth decades. However, they may occur at any time after puberty. The etiology of the cysts and papillomata is a debated question. Cheatle, studying whole sections of breasts, states that they are rarely single. A palpable tumor may or may not be present, but usually is. Pain is not severe. These cysts are usually found near the nipple and in 75 per cent of cases there is a discharge or a history of a discharge from the nipple, often bloody. Bloodgood[5] gives the duration of the intracystic papilloma as from three weeks to fifteen years and Hart[12] from a few days to twenty-five years. A hemorrhagic discharge from the nipple, while not pathognomonic, does arouse suspicion of the presence of an intracystic papilloma. A large number of these cysts can be diagnosed clinically. When opened the cysts contain a clear or hemorrhagic fluid and the papilloma is arborescent and soft.

REPORT OF CASES

Case 1.—R. H., a white woman, aged 55 years, was admitted to the surgical service of Dr. Eugene Johnson at the Baptist Memorial Hospital, August 19, 1934, complaining of bleeding from the left nipple. This began eight months previously and consisted of a quite dark, spotting discharge. There was no pain nor masses.

Physical examination revealed a well developed and nourished patient. The left breast and nipple appeared normal. There were no masses nor tenderness and no bleeding from the nipple. Pressure was not applied to the breast during the examination.

A simple mammectomy was done and the patient had an uneventful convalescence.

Pathological Report.—The specimen consisted of the left breast, partly covered by an elliptical piece of skin, from the center of which the nipple protruded. The skin was everywhere freely movable and no masses were palpated. On section through the nipple and breast several large cysts were seen which appeared to be dilated ducts. Some of these were filled with coagulated blood. Small, smooth, gray pink, translucent, firm, papillary growth projected into these spaces almost occluding them (*Fig. 1*).

There were present small and large cystic spaces lined with a single layer of cuboidal or flat epithelial cells, obviously dilated ducts. Some showed an ingrowth of fibrous tissue, covered by benign cubical epithelium, and their cavities contained red blood cells, serum and large mononuclear cells with phagocytised hemosiderin. The interstitial tissue of the breast showed an increase of fibrous tissue and was infiltrated with lymphocytes, the hemosiderin containing large mononuclear cells.

The anatomical diagnosis was multiple intracystic papillomata.

Case 2.—F. H., a Negro woman, aged 49 years, was admitted to the surgical service of Dr. Ernest G. Kelly at the John Gaston Hospital, October 10, 1935, complaining of a tumor in the right breast. Onset followed

*Read in Section on Pathology, Southern Medical Association, Thirtieth Annual Meeting, Baltimore, Maryland, November 17-20, 1936.

*From the Department of Pathology, University of Tennessee College of Medicine, Pathological Institute.

Fig. 1
Case 1.—Intracystic papilloma of the breast. Left breast, left half, on section. In the dilated duct, furthest from the nipple, is seen a small papillary growth (A) (photograph).

"milk cakes," one eight years and the other three years previously. The latter one was opened in the Out-Patient Department. Pain simulating pin pricks had been felt for two years. The mass was first noticed two years before and had gradually increased in size. There was an intermittent, at times bloody, discharge from the nipple.

Physical examination showed a well developed and nourished patient. Under the nipple in the right breast was a small, firm, nodular mass. There was a bloody discharge from the nipple. No lymph nodes were felt in the axilla.

A radical mammectomy was done by Dr. H. W. Greenburgh, resident surgeon. The patient was discharged, improved.

Pathological Report.—The specimen consisted of the right breast and axillary lymph nodes. There was a palpable mass just beneath the areola which, on section, was seen to consist of two dilated parts of a duct, each 2 cm. in diameter and filled by a soft, lobulated, gray pink, translucent, friable mass, with small areas of hemorrhage, taking origin from the smooth wall lining. Both these cysts emptied into a common duct (*Fig. 2*). The axillary lymph nodes appeared normal.

Section through the papillomata showed a cauliflower-like structure with a coarse, in places hyalinized, fibrous tissue stroma covered by cuboidal or flat epithelial cells of two or three layers thickness. Small hemorrhages were present in the stroma. The epithelium showed no variation of cell type, nor invasion of the basement membrane. Serum was present in the cyst cavity. Axillary lymph nodes were normal.

The anatomical diagnosis was multiple intracystic papillomata.

Case 3.—L. B., a white woman, aged 63 years, was admitted to the surgical service of Dr. Ernest G. Kelly at the John Gaston Hospital, October 18, 1935, complaining of a discharge from the right breast. The patient was struck on the breast eleven years before. This was followed by swelling, pain and tenderness. About three weeks later there was a serous discharge from the nipple which had continued, but was reduced in amount by x-ray therapy in 1930. Following this the mass became firm.

Physical examination revealed a well developed and nourished white woman. The nipple of the right breast was crusted and erythematous and there was a serous discharge from it. Small nodules were felt in the breast tissue beneath the areola. The axillary nodes were not palpable.

A simple mammectomy was performed by Dr. H. W. Greenburgh. Recovery was uneventful.

Pathological Report.—The specimen consisted of the right breast. No masses could be palpated. On repeated cross section two small, intracystic masses were found about 2 cm. deep to the surface, immediately beneath the nipple, one 5 mm. in diameter and the other slightly smaller. Both appeared benign.

Sections showed dilated ducts into which delicate bush-like structures protruded from their walls. The papillary stroma and cyst walls were extensively hyalinized

Fig. 2
Case 2.—Intracystic papilloma of the breast. Right breast, left half, on section. Under the nipple are two dilated parts of a duct, each containing a lobulated, gray, pink, soft, friable mass (photograph).

Fig. 3
Case 3.—Intracystic papilloma of the breast. Note arborescent structure with much stroma and little epithelial covering (photomicrograph X300).

and in places contained calcium deposits. The cysts were lined and the arborescent stroma covered by one to three layers of cuboidal or flat epithelial cells. The epithelium everywhere was benign and there was no blood or serum in the cyst spaces (*Fig. 3*).

The anatomical diagnosis was multiple intracystic papillomata.

SUMMARY

Three cases of intracystic papilloma have been presented, ranging in age from 49 to 63 years with an average age of 55 2/3 years. The duration was eight months to eleven years. The complaint in two cases was discharge from the nipple; in one, tumor. A discharge was present in all three cases, in two it was bloody, and in one serous throughout the duration. Pain was not an important factor.

INTRACYSTIC PAPILLOCARCINOMA OF THE BREAST

That malignant papillomata occur in cysts of the breast has been known since the latter part of the Nineteenth Century when Williams, Bryant and Shield[12] differentiated them from the benign ones. According to Upcott,[6] from four to five of every ten intracystic papillomata are malignant. Greenough and Simmons[3] classify three out of twenty as malignant. It is generally agreed that the malignant ones are most often seen during the cancer age, which is a decade later than the occurrence of the benign ones. However, Hart[12] reports a suggestive case at the age of 27 years. In his series of 24 cases the onset was with a lump in 19, discharge in 3, and pain in 2. The age varied from 35 to 71 years; the average was 51 years. The duration of the tumor was mostly less than three years and in only one case was it over six years. This one grew slowly for eleven years and eventually caused death by metastasis. The criterion for malignancy as established by Hart is: cells vary in size, shape, and staining reaction, invasion of wall and mitotic figures. Frequency of malignancy varies from 15 per cent given by Greenough and Simmons to 50 per cent by Bloodgood. McGehee[7] accepts the ocurrence of cancer in cysts and urges that in borderline cases the idea of malignancy should prevail, since it occurs in about one out of four cases. Bloodgood[4] says that in the absence of clinical signs of malignancy the base of the papillomata should be studied microscopically. Rodman[8] accepts Warren's theory of abnormal involution as being the etiological factor and quotes malignancies in from 13 to 40 per cent of cases in literature.

REPORT OF CASES

Case 1.—S. W., a Negro woman, aged 65 years, was admitted to the surgical service of Dr. J. H. Francis at the John Gaston Hospital, October 12, 1934, complaining of a tumor in the right breast. The patient first noticed a small mass the size of her thumb directly under the nipple of the right breast five months before admission and then two weeks later a bloody discharge from the nipple. This growth gradually increased in size. The patient denied trauma or inflammation of the breast. She had received nine x-ray treatments during the preceding two weeks.

Physical examination revealed a well developed, obese Negro woman. There was a hard, nodular mass the size of an egg directly under the nipple of the right breast, firmly attached to the skin, but freely movable on the underlying tissue. There was no retraction of, but a sero-sanguinous discharge from, the nipple. One or two small nodules were felt in the right axilla.

Roentgenological examination on October 12, 1934, of the chest was negative for metastasis.

A radical mammectomy was done by Dr. Giles A. Coors and the convalescence was uneventful.

Pathological Report.—The specimen consisted of the right breast and axillary nodes. The breast was covered by a piece of elliptical skin. There was a fullness of the upper portion of the areolar region which corresponded to a palpable mass which was freely movable. On section a cavity was seen lined by a smooth membrane, except for a soft, friable, pink, translucent mass

Fig. 4

Case 1.—Intracystic papillocarcinoma of the breast. Right breast, right half, on section. Under the areola is a dilated duct into which projects a pink, translucent, soft, friable mass (photograph).

which projected into the cavity (*Fig. 4*). The axillary nodes were enlarged and on section pink and soft.

On microscopic examination, the mass showed the remains of a papillary structure, but consisted mostly of lawlessly growing large epithelial cells. The cells and their nuclei varied in size, shape and staining qualities and the cells had penetrated the basement membrane into the stroma, but not into the cyst wall. Mitoses were frequent. No blood or serum was seen in the cysts, but hemosiderin was deposited in large amount in the cyst wall. The axillary node showed no malignant cells.

The anatomical diagnosis was intracystic papillocarcinoma.

Case 2.—A. T., a Negro woman, aged 40 years, was admitted to the surgical service of Dr. Morton J. Tendler at the John Gaston Hospital, February 3, 1931, complaining of a lump in the left breast. About two months previously the patient noticed a small lump in her left breast, which was hard and not painful. About the same time she noticed some enlarged axillary lymph nodes. For the previous two weeks there had been a tingling pain in the region of the mass, and occasionally the pain would shoot through the entire breast. On several occasions the mass felt hot as if it had fever. She denied trauma or previous disease of this breast. She grew somewhat weaker, but there was no loss of weight.

Physical examination showed a well developed and obese Negro woman. The left breast contained a nodular tumor mass in the upper left quadrant, which was freely movable. The nipple was erect, soft, and there was no discharge. The axillary lymph nodes were markedly enlarged.

Roentgenological examination showed no masses in the lungs.

A radical mammectomy was done by Dr. J. Murray Davis and the patient was dismissed in good condition.

Pathological Report.—The specimen consisted of the left breast and axillary lymph nodes. The breast was partially covered by freely movable Negro skin. A fluctuant mass about the size of an orange was felt in the upper outer quadrant 7 cm. from the nipple. On section this mass was seen to be a smooth walled cyst containing bloody fluid. A firm, granular, friable, gray mass arose from the wall and grew inward in a fungating manner. Gray projections into the surrounding tissue were seen. The axillary lymph nodes averaged 4 cm. in diameter and were firm, dry, gray, and granular. Some contained blood-filled cystic cavities (*Fig. 5*).

Microscopic examination showed that the arborescent structure in places was preserved. There the stroma was

Fig. 5

Case 2.—Intracystic papillocarcinoma of the breast. Left breast, left half and axillary lymph nodes, on section. In the upper quadrant, 7 cm. from the nipple, is a blood-filled dilated duct from which arises a gray, translucent, soft, friable mass. This tissue is infiltrating the surrounding breast. The lymph nodes are enlarged, gray, translucent and firm with blood-filled cystic cavities (photograph).